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M.E.M.

See p. xi.

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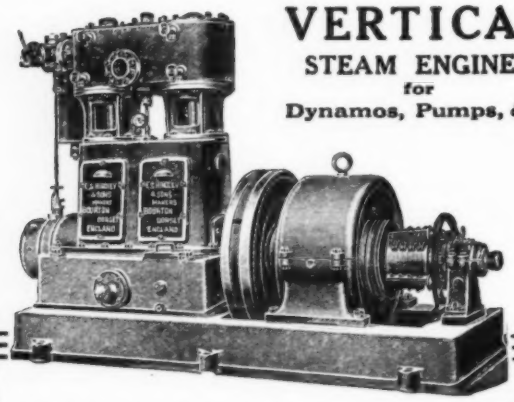

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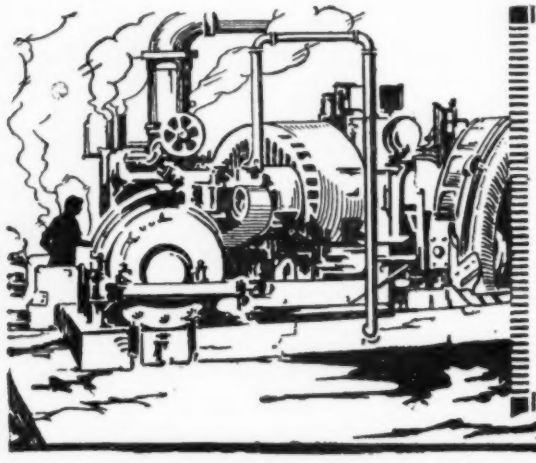

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The

Electrical Review

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LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
Production and Consumption	401
Copper and Lead: Production and Prices	402
The Tramway Report	403
The Lighting of Printing Works	403
National Council of Technical Staff Associations	403
The International Conference on e.h.p. Lines	403
"No British Need Apply"	403
Britain's Most Northerly Electricity Station (*Illus.*)	404
The Bankruptcy of Electrical Firms	405
Standards as a Medium of Cost Control, by E. A. R. Paton	406
Mica and Micanite Insulation, by Archibald A. C. Dickson	408
The Electrical and Engineering Exhibits at Wembley (*Illus.*)	410
The Pacific Cable Board	411
Latin-American Notes	411
Correspondence—	
A Potential Problem	412
A Non-technical Explanation of Power-factor	412
Railless Electric Traction	412
Protection and Unemployment	412
Plumbing Joints	412
Street Lighting	413
Engineers' Salaries	413
The Position of the Colliery Engineer	413
Bankruptcy	414
Small Power Stations	414
Letters of Application	414
Business Notes	415
Lighting and Power Notes	418
Tramway and Railway Notes	419
Telegraph and Telephone Notes	420
Radio Notes	420
Contracts Open and Closed	421
Forthcoming Events	422
Notes	423
Institution Notes	423
Our Personal Column	423
New Companies Registered	424
Official Returns of Electrical Companies	424
City Notes	425
Stocks and Shares	427
The Design of Apparatus for a.c. Circuit Protection, by A. S. Fitzgerald (*Illus.*) (*concluded*)	429
Import Trade of Siam	430
Tramways and Light Railways in 1922-23	431
Transmission Problems, by Major A. M. Taylor	432
The "A D" Primary Cell (*Illus.*)	433
Applications of Electricity and Magnetism in Metallurgy	434
English-Electric Truck-type Switchgear (*Illus.*)	435
New Electrical Devices, Fittings, and Plant (*Illus.*)	436
The Lighting of Trains, Tramcars, and Omnibuses	437
The National Council of Technical Associations	437
Legal	438
Parliamentary	439
Published Specifications	440
Contractors' Column	Advertisement page xxx

Production and Consumption.

FROM the glib way in which people write of "the producer" and "the consumer," it might be supposed that mankind consisted of two separate and distinct orders of beings, the one engaged in producing food, clothing, and commodities in general, for the other to use.

If, however, we exclude that comparatively small section which does not produce, yet has the power to command services, the consumers are really the same people as the producers. All, unless they can get themselves taken on trust, live by selling services of one kind or another to the community; and all live on what they themselves, or other members of the community, produce.

The greatest part of the cost of any article in general use, is that represented by the wages of those engaged in its manufacture. It follows, therefore, that the production of a greater number of articles for the same amount of wages must be beneficial to the consumer, that is, to the producer in one of his aspects. The worker is both a producer and a consumer, and the extent to which the working class is becoming a consuming class is constantly increasing. It was undoubtedly the case in the past that the workers were mainly engaged in producing goods or in rendering services which they themselves would never consume or employ. The improved status and the higher wage of the worker are the causes mainly responsible for this change; and, so long as higher wages are the result of increased production, this is all to the good. It is when, as during the later years of the war, and still more during the post-war boom, wages are constantly increasing while output remains stationary, or actually diminishes, that costs are increased thereby. In such a case a halt must be called sooner or later, and that state of things must come to an end. There has been a general idea that all increases in cost can be passed on to the consumer; as a matter of fact they are so passed, and are increased in the passing. One need only study the share list of companies to see this

proved over and over again. Many shares which, prior to the war, were at a depreciated figure, now stand at a handsome premium. The opportunity has been taken, in making the price adjustments that increases in cost warranted, of adding something to make up for past losses and to provide future profits. The atmosphere at the time was favourable, and people were used to seeing prices rise. The process of lowering prices when the cost of production decreases proceeds, when it proceeds at all, at a much lower power factor.

When the producer is himself the consumer, this habit of passing on increases in cost cannot be quite so satisfactory. It is interesting to speculate whether the advent of a Labour Government to power will have any influence upon these matters. We should like to see it concentrate on bringing down the cost of living, especially where it is maintained at present by the middleman who has acquired the larger-profit habit. But apart from that aspect of affairs, in order that cheapness may exist along with higher wages and shorter hours than those to which the nation was formerly accustomed, there must be increased production and greater output. This will follow, to a large extent, from the improvement of factory equipments, the use of more and still more efficient and complex machinery, the further subdivision of industry, and, so far as it does not stand in the way of progress and development, the standardisation of products.

The housing problem seriously affects the cost of living for industrial and "black-coated" workers, and strengthens the resistance to the demands for economic wages. It is the enormously increased cost of building that has for so long stood in the way of its solution. It may be recognised as a duty of a Labour Government to attempt to deal with this problem promptly, whether in relation to trusts controlling materials or to unions which limit the availability of suitable labour. If it were economically possible to set to work seriously upon a comprehensive national programme, the repercussion of the activity thereby brought about would be felt in every trade and throughout the whole of the industrial and commercial world. It may be objected that such as effort is not, and cannot be, economically possible, but it may be definitely laid down that anything which results in the production of wealth is an economically possible proposition.

Nationally speaking, we must produce goods—that is, wealth—for our own consumption. The complex conditions of modern industrial civilisation, the uneven distribution of the world's population, and the varying conditions in different parts of the earth, make it impossible that every individual shall produce his or her own sustenance, and so the machinery of transportation and distribution is rendered necessary. We have seen, of late years, that oversea markets have become increasingly restricted, partly through the imposition of tariffs upon goods imported into them, and partly, as in Eastern and Central Europe, through disorganisation and consequent impoverishment. We are familiar with the material devastation caused by war, and with that brought about, for instance, by the recent earthquakes in Japan, but in Germany, Austria, and Russia, to take the most notorious examples, we are confronted not so much with material as with moral devastation, and moral restoration is a vastly more difficult problem. In Russia, for example, the land still exists, and its productive power is unimpaired. The people are there, and willing to work to keep themselves alive. Yet the fitting together of these mutually necessary parts of the machinery of production has baffled, and seems likely to continue for years to baffle, those who attempt to accomplish it. It is a tremendous human problem.

At home, our enormously heavy taxation can only be met by the production of wealth in some form or another. Appeals for the reduction of taxation as a means for industrial relief and trade expansion have been put before the Government by representative organisations, and we shall know very shortly how far a Labour Government hopes to go in affording such help for the further lessening of unemployment.

Copper and Lead: Production and Prices.

The recent extraordinary activity and buoyancy of prices in the non-ferrous metal markets has caused a good deal of searching of heart by the big consumers in this and other countries, many of whom have been taken quite by surprise by the upward movement. The activity in copper has resulted in a very substantial advance in prices, which may even proceed still further during the next few months, as at long last the statistical situation of this metal appears to be on the eve of taking a better course than for a very long time. The big producers have had all sorts of troubles in the way of marketing their output since the termination of the war, and having at last succeeded in reducing their stocks to manageable proportions, and being no longer faced with the incubus of heavy supplies of old metal, are able to regulate their policy with less difficulty than of late. The alteration in the American selling arrangements which have been in force between the big producers, hardly seems likely to have any material effect upon the market position, and at all events such considerable quantities have recently been sold both for home and export that for a little while, at any rate, the future appears to be assured. The real strength of the upward movement is based upon the belief that many of the large United States producers can no longer turn out copper at a profit, when the selling price is 13 cents or thereabouts a pound. Already, the poverty of profits arising from the uneconomic nature of the operations has caused several leading companies to pass their dividends, and we are now on the eve of a more or less important curtailment of production. The statistical position is such that a very moderate reduction in output or a very moderate improvement in consumption would eat into the stocks, which to-day are by no means heavy, the total unsold quantity in America being about 140,000 tons, which quantity cannot be regarded as excessive. We shall see fluctuations in prices of course, but the belief amongst the best informed people is that we are definitely heading for a higher range of values in copper, although, of course, there will be periods of irregularity.

The lead position is becoming exceedingly tight, and prices have risen something like £7 since the beginning of the year, bringing the figure to a level only exceeded in 1920. The extraordinary failure of lead production to respond to an exceedingly high selling price is the strangest feature in the situation. Spanish mine-owners apparently are not troubling to increase their output or are unable to do so even at the present very tempting level, their production indeed being considerably less than half of that of 1912, notwithstanding that the price is to-day more than double the average for that year, and there is a discouraging lack of response from nearly all other main producers, with the single exception of the United States. Mexico having again been in the throes of a revolution has only added new difficulties to the general situation, which have been reflected in the recent sharp advance from a little over £30 to the present level. Mexico had, after a very difficult time, commenced to ship substantial quantities of lead to Europe, but the latest upheaval has put a stop to this, and most of the metal which Mexico can spare for export is now being taken by the United States. To add to the difficulties, Germany has lately come into our market as a buyer on a pretty big scale, and for the moment, at all events, there is barely enough lead to go round, with every possibility of an increasing demand and little likelihood of any substantial increase in supplies. The metal admittedly stands at a monstrous level, but conditions are such that it is doubtful whether there is any material relaxation in sight during the next few months at all events.

In our "Business Notices" we give a table showing the world's production of copper and lead during recent years.

The Tramway Report.

WHILE the annual report upon tramways and light railways and railless trolley undertakings, which is reviewed in this issue, contains nothing of a sensational nature, the improvement which commenced in the previous year, after a period of depression, is shown to have continued, albeit at a slow rate.

The best indication of the results of operation is the ratio of the working expenses to gross receipts, and this is seen to have fallen from 82.51 per cent. in 1921-22, to 76.23 in 1922-23. The improvement is greater than that recorded in the last report, but it must be confessed that the ratio still remains high as compared with the 1913-14 percentage of 64.51.

The greater growth of traffic since 1914 than of car mileage which was manifest in the last report, and to which we attributed the overcrowding of systems, was somewhat abated during 1922-23. While the number of passengers carried increased by only 2.18 per cent., the car-mileage increased by 5.97 per cent. The fact still remains, however, that while the traffic has risen by 31.71 per cent. since 1914, the car-mileage has only increased by 3.72 per cent. This economy in working has no doubt had its effect in aiding tramways to weather the storm, but there are limits beyond which it cannot be carried.

The method of classification adopted in the report is such as to indicate very clearly how the tramways stand financially, and it is of interest to note that those in Class 1 (*i.e.*, those who paid their way and showed a clear profit) increased from 81 to 93. At the same time a number of others "moved up" into the better classes, and Class 6, which might be termed the "black list," lost eight members.

It is satisfactory to observe that the position with regard to municipal rates also improved, there having been a net sum of £121,092 taken in aid, as compared with £196,565 in the previous year. We hope that it will not be long before this argument against tramways disappears.

Having examined a large number of reports of both municipal and company undertakings for the year 1922-23, we predicted that improvement was to be the keynote of this report; we see no reason for anticipating any setback during the current year, and we look forward to a record of still further and more rapid advance in the next report.

The Lighting of Printing Works.

IT has sometimes been remarked that while there are many discussions on lighting problems in London, the provinces are apt to be somewhat overlooked. Here there is a good field for enterprise, especially in the form of addresses on lighting problems met with in local industries. A case in point is the lighting of printing works. It would be difficult to find a process where good illumination is more important—yet there are few industries where such strange variations in lighting conditions exist. We could name up-to-date works that are lighted excellently, and in their immediate vicinity there are other works where the methods of lighting are obsolete and entirely inadequate. The remedy would seem to lie in securing the co-operation of bodies representing the industry, and we are glad to note that they are now taking a sympathetic interest in illumination. The popular lecture delivered by Mr. Leon Gaster, at University College, Nottingham, on February 28th, on "The Lighting of Printing Works," was an instance of useful propaganda. Mr. E. H. Lee (chairman of the Health Committee of the Joint Industrial Council of the Printing and Allied Trades) presided, and fully endorsed the importance of the problem. Representatives of several important local printing works were present, and the lecture will doubtless do good service in arousing interest in the subject.

National Council of Technical Staff Associations.

THE formation of a National Council by the Electrical Power Engineers' Association, the Society of Technical Engineers, and the Engineer Surveyors' Association constitutes a further step in the organisation of professional workers. Previously this class, which claims, not without good grounds, to represent the brains of industry, was inarticulate and consequently was unheard in the Councils of the State. The engineer has often been reproached for neglecting to take his part in the conduct of public affairs; individual effort is usually strictly localised, and little impression can be made except by collective action. He has learnt this lesson, and consequently is gradually evolving an organisation which will enable him to play an effective *rôle* in the drama of life. The movement has already borne good fruit, and merits the cordial support of all who are engaged in engineering.

The International Conference on E.h.p. Lines.

A VERY successful informal meeting was held by the Institution of Electrical Engineers on Monday evening, to hear M. Tribot Laspière, general secretary of the International Conference, on its aims and organisation. The most interesting feature f M. Laspière's address was his admirable exposition of the scheme which has been drawn up by the French engineers for the construction of a gigantic network, traversing France from north to south and from east to west, 650 miles in length, of high-pressure transmission lines which will link up the coal mines in the north with the water falls of the Pyrenees, the Alps, and the midlands. By this means the seasonal variations in the output of the hydro-electric installations will be compensated for, and the great towns and industrial areas will be assured of a "cheap and abundant" supply of electrical energy.

The enterprise and ability of French electrical engineers have been fully demonstrated in the articles which Major Rich and others have contributed to our columns; the boldness of their ideas is further manifest in the magnificent lay-out so ably explained by M. Laspière, and our neighbours are to be congratulated on the vigour with which they are developing the natural resources of energy at their command, although from a commercial point of view this country stands to lose thereby a market for some 20 million tons of coal a year. The many problems which arose in the execution of their plans led to the convocation of the International Conferences of 1921 and 1923, and these meetings will continue to be held at intervals of two years. In view of the great value of the papers and discussions, the Conferences, to which the president, Mr. Mailloux, and the general secretary, Mr. C. Le Maistre, of the International Electrotechnical Commission have given the warmest support, deserve our closest attention; and we again suggest that readers who are interested in high-pressure transmission will do well to subscribe in advance for the report of the last Conference, in order that it may be printed in English.

"No British Need Apply."

THE extraordinary action of the Irish Free State Government in negotiating with a German firm for the development of electrical power from the River Shannon will not go unmarked on this side of St. George's Channel. We cannot profess to probe the workings of the Irish mind, as represented by that of the Hon. Gordon Campbell, Secretary to the Ministry of Industry and Commerce; but, as will be gathered from one of our "Notes" to-day, at least one well-known Irishman—Mr. L. J. Kettle—has expressed his opinion of the transaction in forcible terms, and we have no doubt that many of his compatriots endorse his views. Certainly it will be hard to find an electrical engineer of either British or Irish nationality who will express approval of a proceeding so utterly at variance with the dictates of common sense and sound government.

Britain's Most Northerly Electricity Station.

The Kirkwall Installation.

On Monday, February 18th, Mrs. White, wife of the Provost, performed the inaugural ceremony at the opening of the new electric light and power station at Kirkwall, on the principal island of the Orkney group, of Scapa Flow fame. The installation is of interest inasmuch as it is the most northerly electricity generating station in the British Isles.

For the first of the accompanying illustrations of the plant installed in the station, which is the property of the Kirkwall Town Council, we are indebted to Mr. William Rendall, who informs us that the plant was purchased from the Disposal Board.

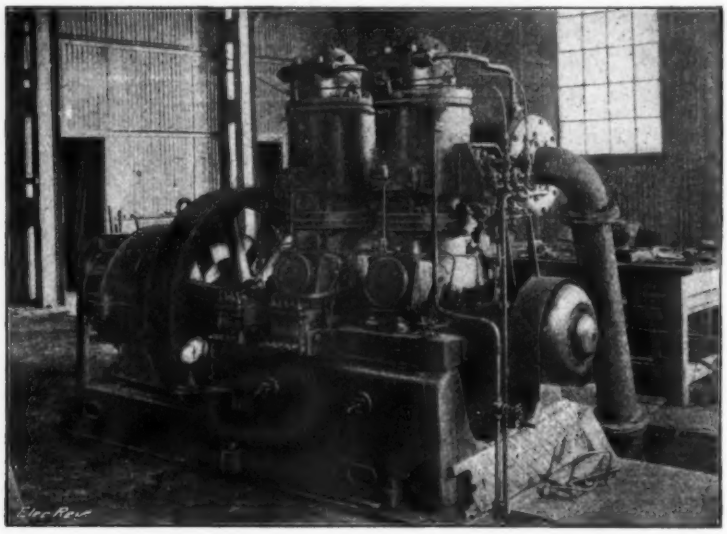

Fig. 1.—A Campbell-Lancashire Diesel Set.

This farthest-north public supply of electricity may be described as one of the good results of the Great War, as the station was originally built by the Admiralty at the Houton Bay seaplane base, about 12 miles from Kirkwall. When the Town Council's offer for the complete power house and underground cables was accepted, Mr. Jas. A. Liddle, of Edinburgh, was appointed consulting engineer. Plans and specifications for the removal and re-erection of the buildings and plant, with the heavy underground cables, in Kirkwall were prepared, and in this connection and throughout the whole layout of the works Mr. Liddle was ably assisted by Mr. D. Miller, B.Sc.

Kirkwall, the capital of Orkney, has a population of about 3,700, and is some 650 miles north of London. A first census of probable consumers brought in close on 200 applications. This was exceedingly satisfactory, and at the inauguration of the supply the harbour, several shops, houses, and business premises received electric light and power.

Conditions in the Orkneys are very different from those of towns in the south, as severe gales of wind and rain are very frequent, necessitating special precautions against damp and vibration. The streets are old-fashioned and in many places narrow, so much so that in the older part of the town a modern charabanc would have difficulty in piloting its way from end to end. The result is that special fuse pillars for the feeders had to be designed.

The power house is about 80 ft. long by 50 ft. wide over the annexes. A three-ton travelling crane runs from end to end of the building, the floor is tiled, and concrete channels below the floor level, covered with steel plates, carry the cables to the switchboard and the exhaust pipes to the pit at the rear, outside.

The prime movers, figs. 1 and 2, are three sets of semi-Diesel crude or gas oil engines of 65 b.h.p. each, by the Campbell Gas Engine Co., Ltd., of Halifax. They are started by means of compressed air, and are fitted throughout with lubrication arrangements of the visible type. Cooling is by tube radiators set in the roof of the building near the louvre boarding, and is so arranged that in the event of the failure of the circulating pumps, a thermosiphon system can be brought into action, the cooling then being entirely independent of the lubrication arrangement.

The dynamos were manufactured by the Lancashire Dynamo & Motor Co., and each is of 40-kW capacity, driven directly from the engine fly-wheels at 350 r.p.m. Electricity is generated at 440 volts, and is distributed on the d.c. three-wire system, 440 volts across the outers, and 220 to the neutral.

The switchboard, fig. 2, is 18 ft. long by 9 ft. high, and was erected by the station staff under the personal supervision of Mr. Liddle, with the exception of the battery charging and discharging board, which is the product of Messrs. Wm. McGeoch & Co., Ltd., of Glasgow. The board consists of three engine panels, battery panels, and four feeder panels, and is complete with the usual instruments, trip gear, &c.; all the panels are of "Siluminite."

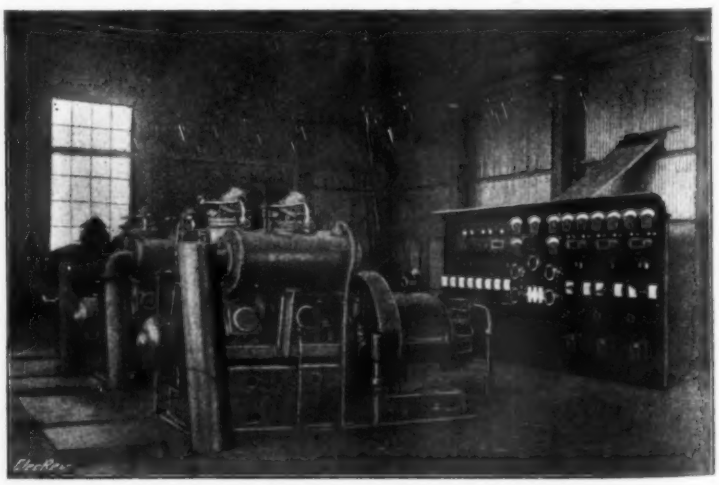

Fig. 2.—Engine Room and Switchboard.

A first-class battery, fig. 3, of 408 ampere-hours capacity at the ten-hour rate has been supplied by Messrs. Pritchett & Gold and E.P.S. Co., and the battery house is a substantial stone building.

The town has been well supplied with electric cables

of ample capacity for future requirements, and fuse pillars of a small neat type have been installed. The administrative staff has been provided with a manager's and assistants' rooms, and lavatory accommodation, while a repair shop, stores, and tanks of large capacity for oil storage have been furnished. The buildings were erected by Messrs. Bell & Robertson, of Aberdeen, and there is ample room for doubling the output before any extensions will be necessary.

The cost of electricity is reasonable, being 8d. per kWh for lighting, and 4d. for power, and the Town Council has appointed Mr. W. C. Roy, late of the Clyde Valley Electric Power Co., resident engineer and manager.

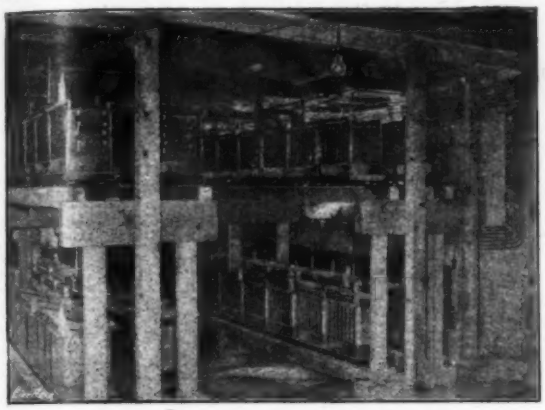

Fig. 3.—A Pritchett & Gold Battery.

In connection with this scheme it is interesting to note that the old St. Magnus Cathedral at Kirkwall is to be electrically lit, and fig. 4 illustrates the old type of lighting device used by the worshippers, who carried candles with them; the candlesticks were used in pairs, and were placed on the pew tops. Fig. 5 illustrates one of the old Orkney cruses, which was filled with oil, dried rush pith being used for a wick. The Cathedral was founded in 1137 in memory of Earl Magnus, of Norway, who was murdered in one of the islands. With the aid of bequests it has been preserved in splendid condition, and forms the place of worship of the Church of Scotland.

Fig. 4.—Old Orkney Cathedral Candlestick.

Fig. 5.—Old Orkney Cruses.

So far about £7,000 has been spent on the undertaking, and by the time it is completed it will have cost about £9,000. It is of interest to note that electricity was first used in the Orkneys for lighting purposes in 1901, at an hotel in Stromness, and later at the Highland Park distillery. The Council has recently also purchased the Kirkwall gas undertaking.

Bankruptcy of Electrical Firms.

By "ELECTRICAL AND MECHANICAL ENGINEER."

Whilst there are many problems arising as a result of consideration of your recent leading article on the bankruptcy of electrical firms, there is one point which appears to be a main factor, especially among the smaller wiring contractors, and that is the question of overhead or establishment charges.

With many of the smaller firms carrying out wiring only, this factor receives little attention and is, in fact, very little understood. This, however, is not surprising when we consider the conditions under which very many of these firms were started.

A wireman may be out of work, perhaps due to the completion of a contract or the failure of his previous employers, and he looks round for something to do. He is familiar with the names of the factoring houses and their depôts, and is in touch with possible clients, and makes a start on sundry repairs using his home address. In this way he earns approximately an amount equal at least to his previous wages, and it is not long before he picks up a lad as an assistant or apprentice to whom he pays 10s. to 20s. per week, and the two working together it pans out all right.

He next gets hold of a wiring job, and finding that he has to leave this in order to do odd repairs, he puts a man to work, renting a little lock-up stores to keep his material, &c.; he thus blossoms out as an electrical engineer and contractor.

He bases his estimating on his own capacity to make, say, £5 a week, and puts a margin of a few shillings a week on to his wage bill for the man and lad, and adds on the rent of his stores, and finding that he can rub along like this he takes on other work on the same basis, and often enough puts on another man, usually an improver.

It is here his troubles begin, as his capacity to earn by his own personal work has seriously diminished. He has to give up time to getting material, seeing prospective customers, going over to a repair which he thought his man could manage but didn't, going to a job completed and paid for, say, a month ago, and refixing a loose switch, or fixing a new one where a doubtful one had been used.

As he is trying to build up a connection, he dare not make any charge if there is the slightest question of faulty material or workmanship.

Again, although he quotes his customer a net price, he seldom has the capital behind him to resist a 5 per cent. or 2½ per cent. discount offer of spot cash from his customer, possibly hoping that he will pick this up by paying his supply house promptly, but he overlooks the fact that he has given the discount on his labour and profits as well as on the material.

Again, there is the question of the man's time requiring to be filled up for odd hours, or even half days between jobs, or whilst waiting for material.

Another point: his customer selects, say, plain polished brass switches, or worse still, flush switch plates, and afterwards chooses an oxydized copper pendant and wants the switches changed.

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He is already aware of 20 per cent. extra for O.C. finish, and this is probably all he expects to pay as extra, although he may possibly be willing to pay the labour cost of changing and may consider that he has been generous to the contractor.

The contractor cannot send the first lot back, as if they have not become chipped or damaged in being fixed and removed, they have become soiled and go into the contractor's stock.

This means that they have to be paid for long before they are used up, and a few of these items soon dig into profits and lock up the nominal capital.

I firmly believe that if proper overhead charges are added to the cost of the average 10 to 20 light wiring job done by wiring contractors the work will show a loss unless the contractor has sold his client a number of fittings and lamps on which he has made the full discount; he will find that it is mainly the repair work that has levelled things up a bit and is keeping him alive, but with one foot in the grave the whole time.

Rent, rates, taxes and insurances, an allowance for faulty material or workmanship cropping up, discounts to customers, and contributions towards cost of getting orders, tendering for jobs and not getting them, cost of stationery and postages and books, together with the very important cost of supervision, all require to be taken into consideration when estimating overhead charges.

The result may tend to increase prices of installation work, but this will be more than counterbalanced by the improved financial position of the contractors as a whole, enabling the wholesale houses to reduce their overhead charges as regards bad debts, and have greater confidence in the contractors.

The wholesale houses have long been accused of supplying fittings, radiators, lamps, fans, and domestic heating apparatus direct to people, but can you blame them altogether, if you consider that they have to choose between supplying them entirely through numbers of contractors of doubtful financial stability or very long credit, or letting a retail customer have them for cash at the retail price and balance this against some of his bad debts?

Another big source of indirect loss to the wiring contractor is his getting out of his depth over things he has no business to touch.

He sells his customer a 2 or 3-b.h.p. motor on about 10 per cent. margin, and wires it up, which is his legitimate trade, but if his customer wants a bit of shafting, &c., put up, he costs up his material from an engineer's supply house and attempts the job, knowing nothing whatever about proper speeds of shafting, relative sizes of pulleys or anything else, and after about three months when the job has been paid for, he had to potter about and attempt to tune up a combination of plummer blocks, wood pulleys and bolts which no proper engineer would ever have put in, finally ending with his customer getting sick of him and handing the job over to a proper firm, and naturally expecting to pay nothing to the wiring contractor.

This article is not written as disparagement of the small electrical contractors, but rather as a help to them to bring their business methods into line with those of sounder firms who make proper provision for overhead charges, and are continually penalised by the stigma attached to the trade generally by the bad financial position of a very large number of firms.

Standards as a Medium of Cost Control.

By E. A. R. PATON, M.A. (Cantab.), A.C.W.A.

Though it is contended that the aid of analogies for solving problems should not be necessary for anyone who is capable of clear thinking, on the ground that it is apt to be more misleading than helpful, it is an undoubted fact that analogies are daily made use of, not only for educational purposes, but in the solution of problems which continually crop up in such industries as electrical engineering. It is not always by exact parallels of the case in point that help may be derived from this method of attacking problems, but more often it is possible to obtain a hint which directs our line of thought into the channel leading to the correct solution.

Undoubtedly, the analogous method is a second rate method of attacking problems; the correct way is to consider the ideal case from the purely theoretical point of view, and having obtained the theoretical result, to make such modifications as actual practice may demand. This method, though the best, is not always possible. It sometimes happens that practice has preceded theory, that no science has been developed whereby the theoretical solution may be obtained. In other cases it unfortunately happens that the purely theoretical solution is beyond our learning! When reduced to such straits, recourse must of necessity be had to second-rate methods, and the aid of analogies must be summoned.

Such is the present state of affairs in the practice of costing in the electrical engineering industry. The demand for more accurate facts regarding costs of production for the three fundamental purposes, control, fixing selling prices, and correct accounting, has arisen rather suddenly, and many of the methods which have been adopted for the apportioning of expenses have apparently been chosen because they seemed simple, rather than because there was any sound reason for their adoption.

The science of costing is developing and developing rapidly, but much still remains to be done before costing practice in this country becomes firmly established on a sound basis, which will admit of its accuracy being proved. Until this has been accomplished, some inspirations for improving methods of costing must be sought by analogies.

It is now common practice in the payment of wages to determine beforehand how long a man may reasonably be expected to take over a job, and thus to calculate what should be a fair wage for this particular piece of work. In other words, a fair price for the job is predetermined and a standard is set up against which actual performance may be compared. It is usual to reward operatives who perform their work in a shorter time than the standard with a monetary bonus.

Similar predetermined standards are frequently calculated and set up for the material which is required for the manufacture of certain pieces of apparatus. For example, the drawing or specification of a certain coil indicates that 100 lb. of d.c.c. round copper wire No. 13 S.W.G. is required to wind 2,000 turns, so 100 lb. is the weight of copper issued to the workman to wind this coil. If the workman actually uses more or less than the amount issued to him, the foreman will probably want to know the reason, and will take steps to find out whether the correct number of turns has been wound on the coil.

Many other examples are easily called to mind where standards are set up, against which actual performances may be checked. Sometimes the standard is expressed in money, sometimes in other units such as time, weight, or number off, the exact unit being chosen for conveni-

ent comparison only, since it is immaterial so far as the principle of setting standards is concerned. In a similar manner many firms set up standards in connection with their sales services, and elsewhere, but for some curious reason it is most exceptional to find a firm that has predetermined any standards in connection with its factory overhead expenses.

Is it not analogous to suppose that if standards have been found a useful means of comparison for the control of labour and material, they are likely to prove equally helpful in the control of overhead expenses? It is invariably the case that the effective control and apportionment of overhead expenses is the greatest difficulty every firm has to deal with in its costing problem, so much so, in fact, that it is frequently content to put up with what it knows to be inaccurate methods rather than devote the necessary time and thought to finding some more satisfactory solution to this admittedly complicated question. The adoption of predetermined standards is, therefore, suggested, not as a solution for all the difficulties of the overhead expense problem, but as a possible contribution towards the more effective control of these expenses.

In order to get to the root of this question, it is first necessary to determine who it is that has the actual control of the spending of the various items which go to make up the total sum of the factory overhead expenses.

There are, or rather there used to be, in the majority of firms in this country, certain " luxury " items of expense for which the management was solely responsible, but in these days of closely cut prices all such expenses, which could be eliminated without reducing the productive efficiency of the plant, have already disappeared. There now remain only two groups of expenses, the first being composed of such items as depreciation, insurance, taxes, &c., which have to be met whether the plant is running or not, and are usually quite steady in amount, their value being, as a general rule, beyond the control of the firm; the second group is a further series of an entirely different character such as indirect labour, factory supplies, scrap and other indirect materials, all of which are absolutely under the control of someone within the firm, and amongst which there is always a possibility of effecting further economies.

Who is the someone who has the control of the expenditure of these items, and is in a position to see whether they are wasted, or whether they are used to the best possible advantage? It is not the administrative staff or anyone else in the offices, for they hardly ever see these supplies and services being used at all; if they do happen to make a tour of the shops for the special purpose of looking for evidence of waste of such services, they may be sure their arrival has been " predetermined " by the workmen and that all evidence of waste has been temporarily removed. The administrative staff only obtain a general survey of the situation as a whole, and have really no effective control of the spending, that is, the actual usage of the services which are classified among these overhead expenses.

Surely, the only men in the factory who have the power to ensure that these expenses are reduced to a minimum are those who are right on the job the whole time, supervising the work of a small company of men under their control, and who come into daily contact with all these elements of expense; that is to say, the foremen.

It may be assumed that a foreman has obtained his position because of some special quality that he possesses, and that he is trusted by the management to see that its wishes are carried out by those under him; otherwise he would not have been appointed foreman.

Foremen usually have ambition and know that their personal success is bound up in the success of their firm as a whole, and particularly in the success of the department over which they have been appointed. They may, therefore, be expected to co-operate actively with the management in its endeavour to keep down expenses, especially if they are offered some incentive to do so.

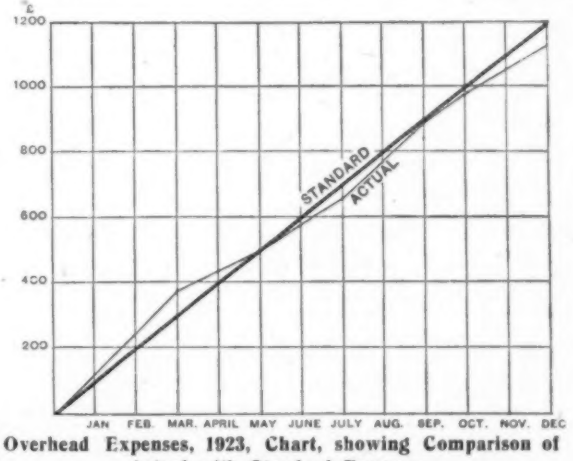
It has now been concluded that the foremen are the authorities who have it in their power to reduce most effectively the majority of the factory overhead expenses, and there is reason to believe that the predetermination of standards for each item of these expenses may prove an effective aid to their efficient control. It yet remains to investigate how this can be put into practice.

The first aspect of the problem is the setting up of standards, being the expenditure permissible for the department of each foreman for the month, or for a period of four weeks.

This is a highly specialised operation, requiring great care and experience, which cannot be done without consultation with all the parties concerned. When the standards are being fixed it is particularly undesirable that any member of the costing staff should attend in any other than an advisory capacity. Since it becomes the duty of this portion of the staff to record, in a faithful and unbiased manner, the actual expenditure, for comparison with the standards, it is unfair to ask them to have any say in the fixing of the standards. It would be like letting a man fix his own piece work prices, and would be likely to place the costing staff in a position where they would be open to all sorts of abuse from the foremen.

The fixing of standards will involve a consideration of each of the items of expense which are to be incurred. Some of these lend themselves to accurate determination, as, for example, the wages of time keepers and shop sweepers, men who are probably paid by the hour; if there are four of these men and they are paid 50s. per week each, this item of expense will be £40 per period (of four weeks). A standard for some of the other items can only be fixed from records of expenditure in previous months; amongst these may be included maintenance of belts, shafting, &c. Other items again are probably best fixed after consultation with the foreman himself, as, for instance, small tools.

Having once determined the standard as a fair basis of comparison for all the items of expense for each department, to the satisfaction of the foreman and the management, they should be listed, and one copy retained by the foreman concerned. The standards may be expressed in £ s. d., quantities, weight, or any other



Overhead Expenses, 1923, Chart, showing Comparison of Actual with Standard Expenses.

convenient unit; there being no reason why all the items on one sheet should be in any one unit at the present stage.

It will be appreciated by those firms which do not wish their foremen to know the actual figures of their expenses, that the adoption of standards in mixed units precludes this possibility.

It may then be arranged for the actual expenditure on each of the items to be noted down every month alongside the corresponding standard, so that the foremen, and all other parties concerned, may see at a glance any cases where standards have been exceeded. It is the foreman's duty to ensure that, over a reasonably long period, none of the standards are exceeded, and it should be his endeavour to keep the expenditure on as many items as possible below the standards.

One firm which has adopted this method of control goes a stage further by plotting the cumulative total standards and total expenses (reduced to common units, *i.e.*, £ s. d.) on a chart which is hung up in the shops. The chart is arranged as shown on p. 407, except that actual figures are, in practice, not shown on the chart.

This same firm carries this procedure yet a stage further. It realises the frailty of human nature, and has instituted a system whereby its foremen receive a bonus, according to the savings shown on these charts, thus adding a powerful incentive to the foremen to co-operate with the management.

It is important to set up standards and to record actual performances against them, but it is equally important that the foremen should be educated to read the figures with understanding, and they should have instilled into them the necessity of keeping expenses below the standards, by explaining how much depends on this being done. They must learn to appreciate that the prices included in tenders are fixed on the assumption that these expenses do not exceed the standard, and that any excess which they do not check means an actual loss to the firm.

The foremen must be told that records of actual performances are obtained whenever possible from requisitions signed by themselves or their deputies, and that these can be seen by them if they have any doubts regarding the accuracy of the figures shown by the cost clerks. In other cases, as, for instance, "electric light," they should know that the charge for this service levied on their department is calculated according to the consumption capacity (in watts) of the lamps in use. They will then take good care to see that lamps which can be done without are removed, and that a 100-watt lamp is not used where a 40-watt lamp would suffice.

The use of standards for the control of factory overhead expenses is a comparatively new thing, and much remains to be done before the principle is perfected, but judging by the experience of those firms which have instituted standards, there can be little doubt of ultimate success.

Mica and Micanite Insulation.—II.*

Varieties, Properties, Practical Tests and Choice of Mica, and the Manufacture and Test of Commutator Micanite.

By ARCHIBALD A. C. DICKSON.

Slab, or block, mica is the trade name given to the thicker sheets of natural mica; usually sheets 0.006-in. thick and upwards are considered slab, while sheets of from 0.002 in. to 0.005 in. are termed films, and when these are split thinner they are called splittings.

There are over 22 separable qualities of the two mineralogical species of commercial mica, the family or group names of these two species being "Muscovite" and "Phlogopite." The former are termed the rubies, greens, browns, spotted, &c., while the latter are generally known as amber, but are rarely amber coloured—still, all shades are sold under the same trade name. These two species, in rare instances, are sold to the consumers under distinguishing names to differentiate qualities possessing certain essential properties, but the common practice appears to be to mix the several varieties of each species and offer them under more general trade names, such as Calcutta ruby (clear, part stained, fair stained, &c.), or Madras soft green or amber, none of which conveys any real meaning as to the various distinguishing properties sought in the mica by the electrical industry.

In addition to these two groups there is the "Biotite," really a distinct group or separate family, but which owing to its being a ferro-magnesian mica like the phlogopite, or popularly called amber mica of the trades, is ignorantly classified and sold as a phlogopite or amber mica, but at a lower figure than real amber; sad to say, it is often used by reputable firms for the insulation of commutator segments. Many dealers mistake it for the black-looking phlogopite or dark amber which has recently been placed on the market.

Sometimes micas of a composition nearer the zinnwaldite, cryophyllite, margarodite, hygrophilite and damourite (which are too inferior, even though approaching the ordinary micas in some minor respects, but still are decidedly different in general appearance and principal characteristics) find their way, in odd lots, to the London market, and are speculatively dabbled in.

All the commercial micas differ from one another, either in mineralogical composition, physical, thermal, or insulating properties which should be carefully tested, studied, and recorded, if the proper mica is to be used for a particular requirement.

For all practical purposes we may say that ordinary light-coloured micas are mostly muscovite, and the black mostly biotite, with one marked exception—the almost black-looking (in thick sheets) phlogopite of Madagascar. The brown, silver-brown, silver-black-green, and the silver are phlogopite.

The optic-axial plane in most of the muscovites passes through the longer diagonal of the base, being perpendicular to the plane of symmetry. In the phlogopite and the zinnwaldite, it passes through the shorter diagonal of the base.

The muscovites (the ruby, white, green, brown, rum, &c., of commerce) are usually rigid or tough, and in thin sheets are elastic or resilient on the flat surface, but on the cut edges they range from the hardest to the softest micas on the market.

The hardness of the muscovites ranges between 2 and 2.5 of Moh's scale of hardness. The specific gravity (sp. gr.) is between 2.7 and 3. The optic-axial angle is from 44 deg. to 78 deg.

The hardness of the phlogopites ranges between 2 and 2.5 of Moh's scale. The sp. gr. is from 2.8 to 3.1. The optic-axial angle is from 3 to 20 deg. But the marked peculiarities about this family of mica are that they are not rigid or tough like the muscovites, nor are they usually elastic or resilient.

The test for rigidity or toughness, which has nothing whatever to do with hardness, tested on the cut edge, is made by pressing a piece of sheet mica on its flat surface. If a small sheet is placed flat on the hand and the fingers under the mica are parted while the thumb is used to apply pressure immediately over the unsupported part of the sheet, it will afford a ready means of testing open to all buyers.

The test for elasticity or resilience is made by taking off a thin film from the mica sheet and bending it round to form a tube one inch in diameter, and then suddenly releasing it. If it immediately returns to its original flatness without injury, it may safely be considered elastic or resilient, and likely to possess all the properties sought in micas of this class.

* The first article in this series appeared in the Electrical Review of November 16th, 1923, p. 749.

In testing it will be found that a hard, tightly laminated mica will hardly yield to pressure. A hard loosely laminated mica will partly yield, and its laminæ will get more loosened. A water inter-laminated mica will yield and appear to be a soft mica, the laminæ will loosen, and on opening will show a film of water. A partly hydrated and weathered, non-resilient mica, like some of the phlogopites, will yield like cardboard; and a hydrated weathered mica will give like damp cardboard.

All hydrous micas, or micas containing excess of water in their mineralogical composition, or between their laminations—being hydrated by exposure—have a more or less greasy feel, are less resilient, and usually sizzle on being heated. Such micas, particularly the mechanically hydrated ones, are much heavier in this condition than they are in their natural dehydrated state. On heating, as happens in use, the water evaporates, the mica shrinks in thickness, and the weight is reduced, so that the consumer buying such mica pays, in some cases, heavily for this useless water-charge, apart from the fact that such micas are decidedly unsafe to use where high potentials are concerned.

The ruby, green, rum, brown, and other clear looking muscovites are the commercial varieties of the potassium micas. Margarodite, hygrophilite and damourite are occasionally mixed with other mica and shipped to the London market. Even though related to the commercial muscovites, they are a form of originally hydrous mica which has a tendency to become more hydrated in humid atmospheres. The partial micas, if I may be pardoned for using such a term, are really not micas in the commercial sense of the word. Their general appearance also condemns them, but still, they deserve mention more as a warning note than anything else.

Cryophyllite, a green muscovite, fuses easily; sometimes thin films fuse in the flame of a candle. It is held that this is apparently due to the unusual percentage of alkali and fluorine in its composition. Its sp. gr. is 2.9.

Zinnwaldite is similar to the above, but contains a large percentage of iron, and the fusion is less easy.

Biotite, which is frequently passed off as a phlogopite (amber), may with advantage be described here. Its colour is dark green to black, rarely brown, but in thin films it looks brown to green-brown, more frequently the latter shade. It is easily detected by the one conspicuous feature that, when a thin film is taken off it rarely flakes or exfoliates without heels, or one gets light and dark patchy shades in the same film. This is due to the twinning between successive laminæ, making an overlapping compound structure, a failing that is also frequently found in the phlogopites (amber micas), hence the claim, by some dealers, that it is an amber mica. The lustre of biotite is more or less pearly on a cleavage surface, while a freshly exfoliated sheet will show a distinct irridescence—another peculiarity fairly common to the dark amber mica of the phlogopite group. But the optic-axial angle of biotite often is less than 1 deg.; the crystals are often apparently uniaxial; hardness 2.5-3 on Moh's scale; sp. gr. 2.7 to 3.1. Most varieties are hydrated, and sizzle on heating.

It is a recognised fact that the electrical strength of the micas, like most other insulating materials, is influenced to a considerable degree by the thickness of the material, or in other words that the electrical strength per mil thickness decreases with increasing thickness; *e.g.*, if a price of mica one mil thick breaks down at 7,000 volts, a piece ten mils thick, of the same quality will break down at 60,000-65,000 volts, and not 70,000 volts as might be imagined.

The thermal properties of mica are not affected in this way but, on the contrary, the resistance to heat is greatly increased per mil of thickness, with increasing thickness in a firmly or tightly laminated mica until it reaches a maximum of 1,200 deg. C. It is, however, reduced in the case of loosely laminated or hydrated micas. Where a tightly laminated mica will stand 600 deg. C., a loosely laminated mica of the same thickness and apparent quality will not stand much more than about 100 deg. C. This is due to the heat penetrating the interstices of the loose laminæ and attacking them singly or in thinner films, so that they do not offer the same solid resistance to heat that the tightly laminated micas offer. The hydrated micas are affected in a similar manner.

This differentiation is of far greater importance than would at first be believed by the majority of users. It tells the intelligent buyer what to look for in mica needed for heater elements. In the absence of the natural tightly laminated mica the best plan is to have the loosely laminated mica sealed or opened (exfoliated or split), then stuck together again by means of a special heat-resisting, non-hygroscopic varnish, so that the whole slab, built upon its own base, will take its original form. It should then be baked and pressed, and after cooling, cut or stamped according to requirement. Mica so treated not only possesses the properties of the natural mica but also possesses the additional property of being less hygroscopic than most micas, as each film is stuck and the cutting or stamping seals the edges. Further, the price of this sealed mica is lower than the price of the same size and quality of tightly laminated natural mica. This class of whole mica sheet built up, on its own base, deserves more attention by the research departments of the large and small electrical firms, as it will solve many a vexing insulation problem. I have tried it myself, and have had exceptional results and good reports from the Continent and America, and I can recommend it whole-heartedly to the manufacturing electrical engineers who are turning out heating and cooking apparatus.

If any student would like to test the difference he should open out two electric irons that have been in use for some considerable time, taking care to select the makes of two firms, one using a cheap loosely laminated mica, and the other using a tightly laminated mica. He will find that the mica in the first firm's iron, where a loosely laminated mica was used, has turned a silver white, and that the edges are easily crumpled if rubbed between the finger and thumb. This shows that the mica is calcined, and the iron gives trouble which results in stamping the make as unreliable. On the other hand, on opening the second iron, he will find that the mica, which was a tightly laminated one, is hardly affected, and the iron is quite safe to use for a further considerable period, which stamps it as a more reliable make. What applies to irons also applies to other heating and to cooking apparatus.

Commutator mica on the other hand, is preferred loosely laminated, as it has to be placed between copper segments, clamped, and turned down with the copper. If a piece of mica is too thick a loose film can easily be removed, or if too thin a film can easily be added before clamping up. For this reason it is universally considered the best practice, where natural mica is used, to use a loosely gauged mica for this purpose; further, if an adhesive were used for sticking the loose segments together, on heating, the adhesive would melt and ooze out on to the copper as a fairly large percentage of adhesive is applied at local spots, and any slight pressure with heating causes oozing. I have already given the properties of the various micas suitable for this class of work. It may, however, be emphasised that great care should be taken to test micas for softness on the cut edges and not on the cleavage plane or flat surface, as, often, moisture between the laminæ increases flexibility along the cleavage plane and is liable to be mistaken for softness. A soft mica best suited for commutator work should not only be as soft as the copper, but it should also possess resilience, split easily and freely without showing heels, and should contain the minimum of water in its composition, which last essential property makes it less hygroscopic than a mica good otherwise but containing a larger percentage of water in its composition, which is a decided disadvantage.

(To be concluded.)

The Electrical and Engineering Exhibits at Wembley.

Preliminary Notices.

As operations are now proceeding apace in the electrical and engineering sections at Wembley, and the official opening is expected to take place next month, we commence this week the publication of brief preliminary or advance notices of exhibits which are of electrical or allied interest.

Fig. 1.—View through the Portal of the B.T.H. Stand.

As our readers will be aware from the plans already published in our pages, many of the stands now being erected in the Electrical Section of the Palace of Engineering occupy extensive spaces, and accommodate electrical plant larger than any exhibited hitherto. They are not to be simple open platforms, as will be gathered from the above illustration, which gives an impression of the British Thomson-Houston Co.'s stand, though it might at first appearance be mistaken for a view of one of the pavilions in the Exhibition Grounds. The stand occupies a floor space of over one-seventh of an acre, and includes such exhibits as a complete automatic sub-station; a large synchronous motor driving an air-compressor; an oil circuit-breaker for outdoor use on three-phase circuits of 110,000 volts, and a wide range of other breakers for numerous voltages and rupturing capacities; many examples of switch and control gear for various industrial purposes; trolley 'bus, railway and tramcar equipments, &c. Among the smaller exhibits are Mazda lamps, lighting fittings, and radio apparatus. B.T.H. motors and control equipments will drive machinery of every description in nearly every building throughout the Exhibition. The model colliery is equipped with complete electrical winding gear, and the power house and sub-stations contain B.T.H. turbo-generating plant, rotary converting plant and switchgear. In an accompanying illustration (fig. 2) we give a photograph showing the power station as it appeared on March 3rd. The completed unit in the foreground is the 2,000-kVA, 3,000-r.p.m. B.T.H. turbo-alternator, which is ready to run as soon as the steam piping has been completed.

MESSRS. MATHER & PLATT, LTD., will be in evidence in many parts of the Exhibition, as their manufactures serve many industries. Every stand in the B.E.A.M.A. section of the Palace of Engineering is equipped, for fire protection, with their "Simplex" chemical fire extinguishers. On their own stand they exhibit pumping equipment for waterworks service as supplied to the Calcutta Corporation. It is an 18-in. "Medivane" pump, driven by a Mather & Platt 580-h.p. motor. They show one of their six-stage "Plurovane" high-lift pumps, driven by a mining-type 100-h.p. motor; a fire pump, motor, and automatic starter set; an 80-kW, d.c. generator and a.c. and d.c. motors. A 500-kW rotary converter, with their patent starting and self-synchronising system, has been supplied to the North Metropolitan Electric Power Supply Co., Ltd., for service in the Exhibition grounds at Wembley, and probably will be open to inspection by the public. The Textile Machine Makers' Association is equipping a working cotton mill, for which the firm is supplying eighteen electric motors for driving machines in this exhibit. Other of the Mather and Platt manufactures, of which particulars will be published in due course, will be found in the power house, also in the mining hall, and among the bleaching, printing, dyeing, finishing and kindred machinery.

FULLER'S UNITED ELECTRIC WORKS, LTD., at their stand in the Palace of Engineering, will have an exhibit of wireless apparatus, dry cells for various purposes, accumulators for wireless, house lighting and portable service, a submarine battery, train lighting cells, miners' lamps and batteries therefor, ebonite boxes, cables for various classes of service, and samples of Fuller's carbon block.

MESSRS. FREDK. BRABY & CO., LTD., will have a "Braby Building," in which there will be oil storage tanks, steel casements for generating stations, &c.

THE CAMBRIDGE & PAUL INSTRUMENT CO., LTD., will be showing instruments covering a very large field, on its stand, but they will also be found in the model power station and at many stands in the Palace of Engineering, the Palace of Industry, and in the British Government Pavilion, the Australian, New Zealand, and other official exhibits.

MESSRS. HOLDEN & BROOKE, LTD., of West Gorton, have one of their "Sirius" high-lift turbine pumps installed underground in the model colliery. It is a motor-driven pump, with a capacity of 600 gals. per minute against 560 feet head.

MESSRS. GUEST, KEEN & NETTLEFOLDS, LTD., of Birmingham, who are exhibiting in the B.E.A. Section, are showing, among other things, samples of electrical stampings by Messrs. Joseph Sankey & Sons, Ltd., one of their associated companies.

MESSRS. ROBERT BOBY, LTD., of Bury St. Edmunds, exhibit elevators and conveyors for grain, sacks, boxes, &c.; pneumatic transporters; refrigerating chambers, &c.

THE DREWRY CAR CO., LTD., of London, shows a 20-h.p. internal combustion railway car; "Alpha" inspectors' light trolley; and a 25/30-h.p. internal combustion locomotive.

THE GLENBOIG UNION FIRE CLAY CO., LTD., of Glasgow, exhibit their firebricks for all kinds of furnaces; special fireclay material for electric and oil fuel furnaces; gas retorts, &c.

MESSRS. FRY'S (LONDON), LTD., show engineers' tools including hack saw blades, reamers, and engineers' taps.

MESSRS. J. & E. WRIGHT, LTD., of Birmingham, exhibit wire ropes for many classes of service.

THE DOMINION MACHINERY CO., LTD., of Halifax, exhibit various wood-working machinery.

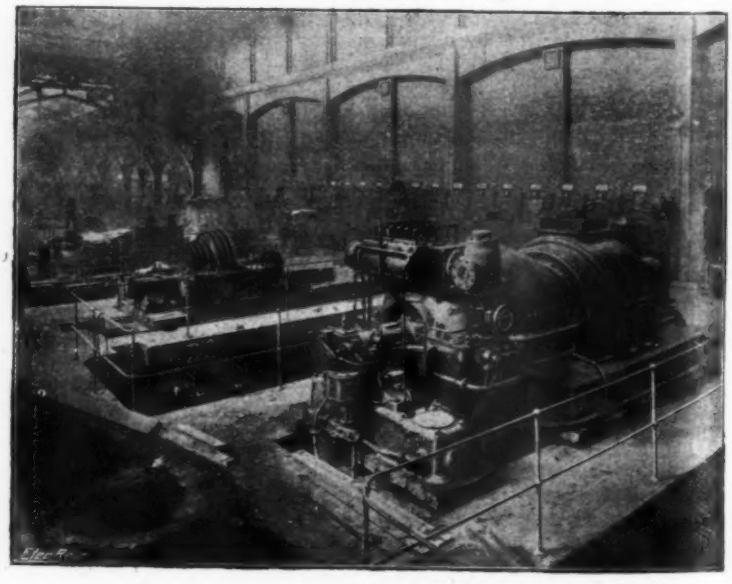


Fig. 2.—A View of the Power Station on March 3rd.

(To be continued.)

The Pacific Cable Board.

Annual Report.

THE report of the Pacific Cable Board (which is formed of representatives of the British, Canadian, Australian, and New Zealand Governments) for the financial year April, 1922, to March, 1923, outlines the year's working and shows that the receipts, £529,228, exceeded the ordinary expenses by £256,299. In view of the duplication of the northern cables, the Board is of the opinion that the whole of the surplus receipts, viz., £169,603, should be employed to strengthen the reserve and renewal fund, which is not yet adequate for the purpose. The traffic receipts (£509,299), fell short by £12,343 of those of the previous year.

There was a substantial increase both in the volume and value of the international traffic. Most of the increase in volume was in the week-end telegrams, the number of words of this traffic being 50 per cent. greater than in the previous year. There was also a gratifying increase in ordinary and deferred ordinary traffic. The anomalous position of the traffic receipts showing a decrease, while the traffic value was greater, arises out of the circumstances in which money is transferred to the Board's account by connecting administrations after the end of the period during which it is earned. The traffic receipts are also affected by the variation in the rate of exchange between the United Kingdom and Canada. The gross revenue includes £16,189 net earned by the cable ship *Iris* for services to other administrations.

The expenditure (excluding special appropriations) was less by £45,242 than that of the preceding year. The total assets of the reserve and renewal fund on March 31st, 1923, amounted to £1,977,363, and the revenue for the six months ended September 30th of the current year was substantially in advance of the estimate.

Throughout the year the cables have worked without interruption, and no repairs have been called for. The Board inserted a new shore end at Bamfield in the Bamfield-Fanning Island cable, which has been down for 21 years, enabling superior results to be obtained by multiple cored cable. It was manufactured by Messrs. Siemens Brothers and Co., of Woolwich. Contracts were placed on February 9th, 1923, for the manufacture and laying of a direct cable between Auckland, New Zealand, and Suva, Fiji, and between Sydney, N.S.W., and Southport, Queensland, with the Telegraph Construction and Maintenance Co., of Greenwich. The manufacture of the trench and conduit cables for the connections between the landing places of the respective cables and the Board's offices was entrusted to Messrs. Siemens Brothers and Co., of Woolwich. The laying of the Sydney-Southport cable was completed on July 11th, 1923, and the Auckland-Suva cable on August 12th, 1923, both within the contract time. The total cost of the new cables, including buildings, apparatus and engineers' fees, will not exceed £360,000, considerably less than the forecast.

During the year under review a small expedition was despatched to Vancouver Island and to Fiji to investigate the possibilities in those localities for radio stations in case it might be found expedient in the future to instal them.

The Board's auxiliary schooner *Tangaroa* has been laid up, and as she will no longer be required by the Board, endeavours are being made to dispose of her. The Board's cable maintenance vessel *Iris* was employed from January to April, 1923, on survey work on the routes of the projected cables between Sydney and Southport, and between Auckland and Suva. In addition she carried out the following repairs:—New Zealand Post and Telegraph Department's Cook Straits cables—July, 1922; Eastern Extension Co.'s Sydney—Wellington No. 1 cable—August, 1922; P.Q. Cable Co.'s section between New Caledonia and Queensland—August, 1922. New Zealand Post and Telegraph Department's Cook Straits cables—September-October, 1922.

The Board sustained a loss by the death of Sir Henry Babington Smith (Chairman of the Board since March, 1914), and Sir William H. Mercer (a member of the Board since its inception) was appointed to the vacant chairmanship. Mr. W. L. Griffith was appointed to the Board in April, 1922, as a representative of Canada, in succession to Sir George H. Perley, K.C.M.G., who retired. Mr. Alexander Lang, C.M.G., retired from the Board in January, 1923. He had been a representative of Canada on the Board since its inception. The vacancy was filled by Mr. Lucien Pacaud.

A new grade entitled "Principal Electricians" for technical officers of outstanding merit was instituted during the year. The number of officers concerned is at present limited to two, and the emoluments of the posts approximate to those of the superintendent's grade. The officers first appointed to the new grade were Mr. G. B. Winkfield and Mr. K. C. Cox. The former is the assistant to the chief electrician, and the second is possessed of much inventive genius.

During the year nearly 10,000,000 paying words of international traffic (*i.e.*, other than local traffic between Australia, New Zealand and the Pacific Islands) were transmitted across the Board's system—approximately 1,300,000 words in excess of the total during the previous year, and was the largest volume of traffic handled in one year by the Board. The full rate international traffic showed an increase of approximately 100,000 words, the deferred ordinary approximately 275,000 words, and week-end telegrams an increase of approximately 1,255,000 words. On the other hand, there was a decrease of approximately 200,000 words of Government traffic, and of approximately 137,000 words of Press traffic. In addition, approximately 2,000,000 paying words were carried between Australia and New Zealand, and between those Dominions and the Pacific Islands—approximately 150,000 words less than during the previous year.

Latin American Notes.

[From Our Special Correspondent.]

ELECTRIC lighting plant in the country towns surrounding Rosario-de-Santa-Fe, in the Argentine Republic, is proving an excellent local investment. In addition to a number of private installations, ten or twelve new sets of plant, some of considerable dimensions, are under contemplation.

The Municipality of Jaguarao, in the State of Rio Grande do Sul, Brazil, is now in the market for a complete electric light plant for the city mentioned, upon which it is prepared to expend 1,000,000 milreis.

An electric light plant will shortly be acquired by the Municipal Council of Esmeralda, Republic of Ecuador.

The Uruguayan Government has decided to utilise the waters of the Rio Negro for the generation of electric power for the city of Montevidéo and its numerous suburbs. The sum of 15,000,000 paper pesos has been allotted for the purpose (1 paper peso=4s. 2d., varying with the price of silver). It is expected that when the plant is in full operation, a saving will be effected of 1,200,000 pesos annually for fuel, besides increasing the supply of electric power by 50 per cent. The plant will have a capacity for producing 1,200 million kW-hours per annum. The dam will prove a considerable aid to the navigation of the Rio Negro by extending its navigable limits for a distance of approximately 100 miles. Work upon the project, which will receive strong financial support from foreign sources, will be started within a few weeks.

The Municipality of Guatemala City has received permission from the State authorities to introduce an electric light and power plant into the capital, and to construct an electric street railway. Other towns in Guatemala which are to be provided with electric light installations include Huehuetenango, Salamá, Zacápa, and San Juan Sacatepequez.

The Municipality of Tegucigalpa (Republic of Honduras) is about to place an order for the construction of an electric light and power plant. The project calls for two water-wheels adapted to a 200-ft. head, 400 cu. ft. per second flow, and direct-connected alternators.

It is intended to install at Buenos Aires a radio station with such a sending radius as will enable receiving stations within 900 km. to receive news and programmes broadcast from the United States, under control of the Radio Corporation of America. It has also been decided to organise a station at Rosario, where receiving apparatus is now being manufactured. A service of quotations, supplied by the Board of Trade at Buenos Aires, has been arranged for.

In Cuba, a radio-telephone service has been opened, messages being received daily from the United States. An installation has been erected in the Presidential palace, while numerous private installations have been connected up with the central station of the Cuban Telephone Company.

The Mexican Department of Communications and Public Works is about to contract for the installation of wireless stations to connect up the more distant parts of the Republic. When these new installations have been completed, Mexico will have over twenty-five wireless stations, constituting one of the most perfect wireless systems in Latin America.

"Underground" Power Consumption.—The Underground Electric Railway Co. is endeavouring to interest its staff in the question of power consumption, both by the trains and other equipment. It is realised that in the production of each kWh of electricity more than 2 lb. of coal are consumed and that something like 800-900 tons of coal are burnt per day at the power station. Of the power consumed by the trains, escalators, lifts, pumps, and for lighting, 80 per cent. is incurred in train movement. The company has various educational means for the instruction of drivers, by the use of recording ammeters, wattmeters, coasting recorders, &c., and has for some time past exhibited large charts at the respective depôts showing the amount of electricity consumed. The company is now trying the new idea of showing the amount of energy consumed per car mile in the weekly traffic circular which is distributed throughout the lines, and it is hoped that the men will make a study of the charts. An interesting competition has been commenced in which members of the staff are invited to write an essay on "Why the consumption varies for the different lines and how it may be reduced."

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

A Potential Problem.

Will some kind reader deal with the following query:—A copper ring of uniform cross section is placed in a uniform alternating magnetic field, in such a position that a current of steady average value circulates in the ring. Are there points around this ring that differ in potential? If so, where will they be situated? It is usually assumed that a flow of current causes a drop of potential along the conductor that conveys it.

F. A. G.

March 5th, 1924.

A Non-Technical Explanation of Power Factor.

I am interested in Mr. Dorey's letter on my article, but I would like to make it clear to him that the metaphor of spitting idle current into the mains is not random. The fact is business men *demand* explanations of things like power factor, &c., and then refuse to listen if the explanations do not interest them. These words, which have struck so many people, were used for the very purpose of getting attention. Once the attention of the victim has been secured, one may proceed with less aggressive terms. The words are useful because they make it quite clear that the production of idle currents is due to a defect in the motor, and not in the method of supplying electricity. Probably those who read the criticisms only will imagine that I harp on the words "spitting back" a great deal, but anyone who has this opinion will be able to correct the impression by reading the article itself.

If I were explaining Mr. Dorey's condenser I would feel tempted to say that it is very much like the gas bag which is used on gas engines to prevent the pulsation affecting the gas supply. While this explanation may not be very accurate, it gives the consumer a fairly good idea of the functions of the condenser.

By the way, is it not time that we got rid of the word "condenser," which is an unfortunate term for dealing with electricity, which acts like an incompressible fluid? Personally, I would scrap it and the word alternating, and replace the latter with oscillating. Wireless men have done this, and it has aided clear thinking.

C. Turnbull.

North Shields, *March 4th*, 1924.

I do not feel inclined to join issue with "Cui Bono?" on the subject of the literal or technical accuracy of the analogies put forward by Mr. Turnbull and myself. Very few analogies are perfect, and I should be satisfied with any analogy which served its purpose without misleading. If, for example, I said that a suet pudding was as heavy as lead, "Cui Bono?" might refer me to a table of atomic weights and prove me to be wrong in my statement, but most people would understand what I meant.

Of the need for a non-technical explanation of power factor, there can be no shadow of doubt.

As to whether the competition has served its purpose, we shall only know definitely after a year or so has elapsed. The Power Factor booklet will be published in a few weeks' time, and will reach most of the supply authorities. If one or more of the explanations or analogies gets adopted—with or without modification—we shall know where we are, but, in any case, it is difficult to imagine any engineer who has perused the booklet not drawing on its contents to some extent the next time he is up against the problem of explaining power factor to a non-technical consumer.

R. Amberton.

London, *March 3rd*, 1924.

I believe the most useful explanation of power factor to a non-technical power consumer is, first, the analogy of an induction motor with an hydraulic lift. This, with a pressure of 2,000 lb. per sq. in. on a piston of 100 sq. in., would lift 200,000 lb., say, 60 ft. in 60 seconds, provided the pressure at the pumping station was 2,200 lb. and mains and valves were large enough to allow the water to flow with little loss of pressure. This might be called 100 per cent. or unity power factor at the lift, and 90 per cent. efficiency from the pumping station. If 20,000 lb. were required to be lifted 60 ft. in 60 seconds, the same amount of water would be required, and the power factor would be 0.1 only, with an efficiency of 10 per cent. at the lift, and if 2,000 lb., the power factor would be 0.01, with an efficiency of 1 per cent. at the lift.

The second analogy is with a steam engine with a stroke of 1 ft., a piston area of 1 sq. ft., and a speed of 100 revolutions per minute, requiring 200 cu. ft. of steam per minute. This, with a mean effective pressure of 40 lb. per sq. in., is equivalent to 35 i.h.p. If it were exhausting into a perfect vacuum we might term it 100 per cent. steam engine efficiency and unity power factor. But if the engine were doing only 3½ h.p. and exhausting to atmosphere with a mean effective back pressure of 20 lb., although only doing one-tenth of the work, it would require 200 cu. ft. of steam at 24 lb. mean effective pressure, and its power factor would be less than 0.1 and efficiency 10 per cent.

Something similar happens with an induction motor of, say, 200 h.p., at 500 volts, three-phase. This would require, say, 80 amperes at no load, running at full speed, 150 amperes at half load, and 200 amperes at full load, these being examples of, say, 0.01 power factor at no load, .58 power factor at half load, and .86 power factor at full load.

W. H. Sisson.

Bolton, *March 8th*, 1924.

[This correspondence is now closed.—Eds., Elec. Rev.]

Railless Electric Traction.

May we be permitted to offer a few criticisms on the paper read before the Liverpool Engineering Society by Mr. T. Molyneux, M.B.E., M.I.Mech.E., on the subject of "Tramways and Roadways" an extract from which you published in your issue of February 29th?

As the pioneers of railless traction in this country, we cannot altogether agree with certain statements made on this subject. The author of the paper states that "inherently the vehicles are driven as far as possible in the one course, and there is therefore a tendency on inferior class roads to form ruts in the surface."

As the railless car, equipped with our patent cam-controlled trolley base, can deviate from kerb to kerb of a 40-ft. road without any fear of de-wiring, there is no necessity whatever to retain a position under the overhead line. In practice, the tendency suggested is no more marked than in any other form of mechanical road transport, and during our many years of experience we have never before heard this objection raised.

We do not know where the author obtained the figures on which he based his table of working costs, but it is interesting to note that the actual figures per passenger carried, deduced from the statement of accounts for the year ended March 31st, 1923, published by the Birmingham Corporation, where all three types of vehicle are in service, make the comparison more favourable for railless vehicles.

Working Cost per Passenger Carried.

Railless Cars	.928 pence
Tramcars	1.232 pence
Motor-buses	2.169 pence

(The above figures do not include capital charges.)

These exceedingly favourable results of railless traction were obtained with cars of the twin-motor type supplied by us.

Railless, Limited.
S. V. Sipps.

London.
March 7th, 1924.

Protection and Unemployment.

As a humble member of a great profession, and one who has "stuck to his last" and not dabbled in politics, I read with interest, in your issue of February 29th the article on "Prices," by Mr. D. N. Dunlop, and on the following page the statement respecting the Bradford contract for converters. Due, I presume, to man's primitive instinct for self-preservation, I have always felt that Protection would tend to relieve unemployment. My Free Trade friends, however, assure me that my view is quite wrong, as imports *must* be paid for by exports, in fact, the more we import the wealthier we are. If my friends are correct, the Bradford City Council has acted wisely in placing the contract for converters in Belgium, but this does not "square" with Mr. Dunlop's argument in the article referred to above.

There is something wrong somewhere; what is it?

H. C. Silver.

New Malden, *March 4th*, 1924.

Plumbing Joints.

The correspondence columns of the Electrical Review during the past two weeks have produced some most practical and interesting evidence germane to the issue raised by Mr. Welbourn, as published in your issue of February 15th, 1924. But nothing really scientific has appeared. There is, from a practical point of view, a most undesirable physical time-lag implied in Mr. Frank Gould's letter published in your issue of February 29th. Temperature is everything in securing a sound wipe. Hence speed and "sleight of hand" are essential, the proportion of tin and its exact location being all-important. When the freshly completed wipe is still more or less plastic, tin can be drawn to the surface by the instant application of tallow. Cooling primarily takes place from the exterior, the spongy porous lead-tin alloy hinted at by Mr. T. A. G. Margary. Rapid cooling of anything crystalline invariably tends to produce planes of weakness and a porous state which is typified in the foundry with cast iron, its cooling and shrinkage. The "overcast" joint referred to by "J. R." was sound, but is extinct. The absurdity of using tallow as a caulking agent must be obvious to all. Spitting on a finished joint is useless, as applied to a wipe,

but is very efficacious when applied to non-electrical work where the use of properly "killed spirit" as a flux is permissible in conjunction with a soldering iron, or copper bit; but this is without the scope of the subject raised by Mr. Welbourn. "Peeping Tom" would be a public benefactor if he would publish the name and address of manufacturers of "eights." For upwards of 30 years I have carefully preserved a piece of composite candle, which I believe to be a mixture of tallow and resin. Where did it emanate from?

W. E. Rogers, A.M.I.E.E.

London, *March 9th*, 1924.

Street Lighting.

The "Notes on Street Lighting" in last week's issue of the Review were interesting, not only because of the excellence of the article itself, but for other reasons, chief among them being the appalling inefficiency of the bulk of our street lighting to-day.

When one considers the great increase of road traffic and of accidents, the question becomes one of both importance and urgency. Whilst it would be ridiculous to attribute street accidents only or even principally to inefficient street lighting, it is obvious that the various authorities will not have met their responsibilities in the matter until the areas under their control are satisfactorily lighted.

There are difficulties, of course, financial and technical, but the remedies are comparatively inexpensive, and there is no doubt that a reasonable degree of efficiency is obtainable, provided that the installation is designed with discretion.

From the point of view of the illuminating engineer, the first difficulty is the wide spacing, often accentuated by the necessity to utilise existing lamp posts spaced at even greater intervals than necessary. It follows that an efficient reflector of wide distributing type becomes essential, and brings home the point made by "E.M.B." that "the reflector is the important link in the lighting equipment."

Another problem linked up with the one just mentioned is that in order to secure sufficient intensity, rather high-candle-power lamps have to be used; consequently the difficulty of glare frequently arises. There are, however, solutions.

A consideration which does not seem to receive the attention it deserves is that the ordinary lighting unit throws a circle of light, whereas street lighting really demands an elongated form. It is quite practicable to effect this.

"E.M.B." rightly refers to the necessity of designing fittings so that adjustments can readily be made in position. He goes on to advise, however, that large nuts and screws should be used, because small sizes are inconvenient and easily lost. One can go farther than this—a lantern which needs adjustment in position should be dependent on loose parts.

The question of glare is also important, but can be dealt with satisfactorily, and here the writer (if the Editor is kind) would like to construct a friendly argument with "E.M.B.," who suggests that for smaller streets, and because of glare, vacuum lamps should be used in preference to gasfilled ones.

The Writer: Gasfilled lamps are the more efficient.

'E.M.B.": Yes, but what about glare?

The Writer: Use an anti-glare method.

"E.M.B.": And lose the efficiency.

The Writer: That depends on your method.

And having made his point by the time-honoured method of putting words into the other man's mouth, the writer brings his contribution to a conclusion.

Ben Ansell.
Smith & Ansell, Ltd.

Birmingham, *March 3rd*, 1924.

Engineers' Salaries.

I think all technical engineers will be very grateful to you for publishing the information compiled by the S.T.E. on salaries. The sentiments expressed are essentially moderate and present an only too true picture of the prospects of an engineer in this country. Engineers, as a whole, took up their profession because they were enthusiastic about their work, and this enthusiasm naturally makes them of more value to their employers than if they worked merely to make a living. Yet it seems quite fair to state that employers take advantage of this fact to pay their staff the very minimum salary on which a man can live. From a moral point of view, this attitude is indefensible. However, we should be told that morality doesn't count in business (hence all the present and increasing discontent in the industrial world). Even looked at from the strictly business point of view, can business men not see that it really would be worth something to them in £ s. d. to have their business run by men who really feel that they are getting a square deal and not being exploited? There will always be malcontents in every walk of life, but I do maintain that the desire of technical engineers for a substantial increase in the standard of their salaries is absolutely reasonable; that the industry could afford it; and that public opinion (if the public knows anything at all about the work of engineers) would heartily endorse it. As a body, engineers are certainly not avaricious; though we believe our work to be of "national importance," we do not expect to make as much as those who sell, say, bacon, tobacco, or quack medicines, for which callings no expensive training is required. The fault, however, does not rest entirely with the employers; many technical men are content merely to grumble, being unwilling to lift a finger to improve their status and that of their fellow workers, while many are completely devoid of any business instinct. This is in some ways a meritorious attitude, but, unfortunately, most men are not made that way. Public opinion is a mighty force, but the public, though served in so many ways by engineers, is hopelessly ignorant of what engineering means. For this we, as a body, are to blame. Personal modesty is an excellent virtue, though surely it might be relaxed a little in the judicious use of propaganda amongst the general public for the benefit of the whole industry?

The Society of Technical Engineers would be doing a useful thing if it collected data of the salaries of other professions of approximately equal standing to that of engineers. Published side by side with those of engineers of corresponding ages, they would make interesting reading, and might lead to some improvement. Is it not better to listen to reason than to wait to be compelled? I am not necessarily a believer in collective action as being a good thing in itself, and am not a member of the S.T.E., or any similar organisation.

Some people say that it would be unwise to organise, as the standardisation of salaries would be bad for the prospects of the brilliant men. Yet, is there a single case in which the action of the E.P.E.A. has led to the reduction of any man's salary or prospects? Possibly the world would be better off if no form of trade association or union were permissible by law, but if one section of the community starts combining, it seems inevitable that the habit must spread to all sections as a matter of self-protection. The reason why technical engineers are not organised as yet is because it is a new profession. Perhaps some day we shall have an amalgamation of the big engineering institutions which will be constituted on similar lines to the British Medical Association. Do the employers want this to come to pass? If not, it is open to them to, at any rate, delay it by reasoned consideration of the point of view of their staffs. Surely engineering should be self-supporting as a profession, and the S.T.E. makes a great point when it states that it is impossible for the average technical engineer to bring up a son in the same profession.

We are reasonable people and not entirely ignorant of economic laws. If it could be definitely proved that manufacturers could not afford to pay higher salaries, we should be satisfied. Though trade is not as good as it might be, most electrical manufacturers are earning larger profits than they were before the war, but has any one benefited much by this except the shareholders?

X Y Z.

March 1st, 1924.

The Position of the Colliery Engineer.

At the outset I wish to make it quite clear that no one realises more than myself the vast amount of good the A.M.E.E. has done in educating manufacturers, mining electrical engineers, and others, thereby promoting increased safety and efficiency of electrical plant in mines.

There still remains a great deal to be done, and I therefore regret that the Council of the Association has adopted an antagonistic attitude towards the question of a Government certificate, without considering more fully the wishes of the rank and file; I am convinced that the majority are in favour of such certificates.

It will serve no useful purpose to quote fully the sins of commission or omission of which mining electrical engineers, including myself, are guilty; many are perhaps unavoidable, but the electrician in charge who connected up a 0.0225 sq. in. cable to a 0.3 sq. in. cable without *any* protective device in circuit, and another who did not know whether the neutral on the turbo-alternator was insulated or earthed, must be considered incompetent.

It is natural to assume that breakdowns and accidents are more likely to occur with this type of man, and in that respect they must be considered, indirectly, detrimental to the A.M.E.E. The more one studies the Memorandum of Association the more one wonders how the Council can take a detached view of this question, for surely it is promoting safety and increasing the efficiency of electricity in mines to eliminate (in time) the type of man who is mentioned above.

In his presidential address to the A.M.E.E. at Cardiff, in 1920, Dr. W. M. Thornton, who is so intimately connected with the safe use of electricity in mines, said:—"Again if thought desirable, since the lives of many may depend on his competence, it should be open to any working member to have his technical competence certified, not only by the Association as we have it now, but by the approval of the Department responsible for safety in mines. Such an approved certificate it would be the aim of all engineers in charge of mining plant to possess. It would relieve the minds of managers from the difficulty of judging by hearsay without tests whether a man is competent under the Act."

Another gentleman, who has been prominently connected with the Association for many years, asked, in 1921, if it was the policy of the "Mining Electrical Engineer" to oppose the granting of an official status to mining electrical engineers, and continued his letter as follows:—

"Such a policy would, I believe, be found to be quite at variance with the opinion of the majority of the members of the A.M.E.E.

"Why else had the Association so consistently boosted the desirability of examinations, and so often and so repeatedly

in discussion expressed the strongest feeling in favour of the setting up of a definite standard of efficiency as regards its members? Surely, if it is necessary for the good of the community that such men as mine managers and marine engineers should hold tickets guaranteeing their qualification, it is equally desirable that the mining electrical engineer—who no less than they holds the lives of others in his hand—should be equally beyond suspicion."

These views are worthy of serious consideration, and in my opinion the A.M.E.E. would not only gain in prestige, but in numbers if, by the legitimate use of its power under the Articles of Association, it assisted in obtaining official recognition.

The honour of being the founder and first secretary of the A.M.E.E. belongs to Mr. J. Glynn Williams, and not to myself as suggested in your issue of February 8th.

T. H. Williams.

Barnsley,
February 4th, 1924.

Bankruptcy.

The question raised by your leading article of February 29th is one of such importance that we trust it will meet with serious attention from all branches of the trade.

Your plea for a system which would secure consideration to the trader hard pressed by circumstances, and trying to do his best, must appeal to every large firm, for, however hard the battle of modern commerce, firms with large businesses are not without hearts and would like to see the embarrassed trader get fair play and assistance. You put your finger on the difficulty of assisting such. Under existing conditions, creditors are in most cases in the dark as to the condition and standing of the business of customers who are unable to meet their accounts promptly, and want extended credit.

Your suggestion of a representative commercial organisation to deal with such cases, particularly as outlined in your second last paragraph, appears to us admirable. While traders are naturally shy of taking individual creditors into their confidence, they would probably open their minds to such an organisation once they were convinced that the information they gave would be held in implicit confidence. Such an organisation would encourage stability, and produce a better credit tone. It would also obviate the largeness of present provision for bad debts, which has of necessity to be handed along, in the price, to the customer.

It will be interesting to watch the effect of your article, and if it results in the adoption of your suggestion, much good will have been done to the trade as a whole and to every member of it, large or small.

Concordia Electric Wire Co., Ltd.
F. T. O'Hanlon.

New Sawley, *March 3rd*, 1924.

Small Power Stations.

Some time ago I wrote in your columns an article on our little village electric lighting scheme, and endeavoured to show to others the possibilities and advantages as applicable to them.

In advising small towns and villages to adopt electricity, obtained either in bulk or from a small generating station, three virtues must be evident, *viz.*, advantage to the inhabitants, an inducement to adjacent town people to build and reside, and collectively help to reduce unemployment. In your current issue gas is mentioned in conjunction with electric light, and to save gas companies I quite agree with the proposition, but in small districts gas is dear and, this being so, there is no hope for gas to have preference over electric light. Electricity is, without doubt, the last word in artificial lighting, and, if skilfully managed with regard to load factor, a very attractive tariff can be put forward in the way of daylight charges. It must be borne in mind that a country station is practically only run at night from dusk until shortly after midnight, before and after which a battery takes up the load. This method takes the profit off the peak load, and while the establishment charges are almost as much as for a 3-shift station, the earning powers are limited to less than one shift. This is where a daylight load comes in, and even though a great reduction is made on kW-hours supplied in daylight, a steady income over expenditure will result, which would not otherwise be available.

Our little station started with 16 consumers, has now 50, and will have about 80 by 1925; it is showing a profit balance this year, and I am of opinion that councils and persons interested in such towns and villages would do well to thoroughly and earnestly consider the lighting by electricity of such towns and villages. We are a decade behind the States and the Continent in this matter, yet many of our towns and villages are close to good water supplies where power could be obtained with very little structural or earthwork expense. Of course, it is false to think there is such a vast saving in water power. At the outset there is only a matter of 1d. per kWh and, taking into consideration extra capital on plant, greater battery capacity needed in case of floods and drought, &c., there is very little advantage to offer to the consumer unless he is a large consumer; again, obviously, large consumers do not exist in such small places. Any one interested in this question may receive further information either through these columns or by letter to the writer.

C. F. Wood,
Engineer and manager, Newcastleton Electric Supply Co., Ltd.

Newcastleton, N.B., *February 25th*, 1924.

Letters of Application.

As an official in a large engineering concern, it is one of my duties to advertise for and engage technical staff, which duty entails the reading of many hundreds of applications per year.

My experience has convinced me that considerable time could be saved by both the applicant and the employer if letters of application were made as brief as possible and laid out in such a way as to give essential information in concise form.

I take the liberty of making the following suggestions for arranging a letter of application, which if acted upon would, I am sure, save time both in writing and reading:—

(1) Print name, address, and date in block letters at top.
(2) Give reference to the advertisement.
(3) Age and salary required.
(4) Technical education (stating degrees, diplomas, &c.).
(5) Experience (give list of firms, positions held and periods employed, in tabulated form).
(6) Special qualifications (make any comments desired regarding special qualifications for the position advertised).
(7) Earliest date upon which duties could be commenced.

Do not attempt to write a letter; tabulate everything. Do not send original references and, if copies are sent, attach them by means of an ordinary pin.

The whole of such an application could be written on one side of a quarto sheet of paper.

Only those who read applications in quantities can appreciate the work involved in sifting the important information from a chatty little epistle of three or four pages. As fully 50 per cent. of those received fall under this category, the total amount of useless work done by both the applicant and the recipient is considerable.

It may be argued that the orthodox letter provides a good means of forming an opinion of personality, but for technical work the first essentials are training and experience and a subsequent interview will give an opportunity for judging the man himself.

I trust these few remarks will be received by those of your readers who are interested, merely as a suggestion to assist early consideration of letters of application and prompt replies.

Recipient.

March 4th, 1924.

Letters have been received, too late for insertion in this issue, from Implitico, Ltd., Mr. W. Ellerd Styles, "Contractor," "Only a Wireman," and "H. W."

Germans Harnessing the Shannon.—A scheme for harnessing the River Shannon is announced in official correspondence published in a White Paper by the Free State Government. Messrs. Siemens, a Berlin engineering firm, have been in communication with the Free State Ministry of Commerce and Industry on the matter, and have undertaken to provide a scheme of development on a large scale, subject to conditions laid down by the Government. One of the clauses is that, if the scheme preferred by the engineers is adopted, the Government may undertake it as a State matter or, failing this, give Messrs. Siemens the first opportunity of carrying it out. If the latter be unable to finance the scheme, the Free State Government will pay £5,000 for the time and money expended by Messrs. Siemens in its preparation. The engineers' report is to be produced on or before September 1st, 1924, and the Free State Government will lend the services of two junior engineers and some unskilled workers to assist in the survey work. The scheme, when prepared, is to be submitted to experts nominated by the Free State Government, and if they do not approve it, after reasonable opportunity for modification, the whole arrangement is to lapse. The correspondence concludes with a letter from Messrs. Siemens accepting the Government's proposals, and stating that they will proceed with the necessary preliminary investigations, sending their engineers to the Shannon as soon as it suits the convenience of the Government. Commenting on the proposal, Mr. L. J. Kettle, city electrical engineer, Dublin, and hon. secretary of the Electricity Supply Association of Ireland, stated to a representative of the *Freeman's Journal* that it was a "most amazing proposition," and expressed astonishment that a monopoly of such a sweeping character should be promised to any firm, "for absolutely no value received." The people who were most interested in the electricity supply industry in the Free State had not been consulted. As Mr. Kettle pointed out, if the Siemens scheme was to be reported on by experts, the Government might as well have left out Siemens's and retained the experts in the first instance, after which proposals could have been invited from contractors. The Government had not been fully informed or wisely advised on the matter, and it had rejected the assistance offered by the Association which represented electricity suppliers in the Free State. He thought the proposals could not be allowed to stand.

Business Notes.

Bankruptcy Proceedings.—C. W. HOLMAN (Hudson's Electrical Engineering Co.), electrical engineer, 7 and 8, Prudential Buildings, Park Row, Leeds.—First meeting, March 13th at the Official Receiver's office, 24, Bond Street, Leeds. Public examination, April 1st at the County Court House, Leeds.

T. DAVISON (Radio Technical College), 30, Falkner Street, Liverpool.—Application for discharge to be heard April 4th at the Court House, Liverpool.

FRED. PARLETT, electrical engineer, Park Royal Hotel, Leinster Gardens, Lancaster Gate, London, W., and formerly of Mansion House Chambers, E.C.—The public examination of this debtor was held on March 4th at the London Bankruptcy Court before Mr. Registrar Mellor, the accounts showing liabilities £636 against assets £13. In the course of his evidence the debtor stated that in April, 1919, he entered into a verbal partnership with Mr. J. E. Bradbury and Mr. Neil M. Ross, who provided a capital of £250 each, and they thereafter traded as electrical engineers at Mansion House Chambers under the style of "Fred. Parlett & Co." Witness provided no capital, but he had experience of the trade, and it was agreed that he should receive a salary of £5 per week and an equal share of the profits. The trading was not successful owing to lack of working capital, and in December, 1920, the business was discontinued. He had since traded on his own account, buying and selling electrical goods, purchasing wholesale for cash, and selling them to retail traders. In 1920 a consignment of electrical goods, purchased from Germany, was taken over by the firm's bankers, and the goods were ultimately sold considerably under cost, with the result that he was liable to the bank under a guarantee given by his partners and himself to secure an overdraft. The failure was due to that liability and also to a judgment obtained against him in respect of clothes made to his order, but for which payment was demanded before delivery, which never eventuated. The examination was concluded.

VALENTINE GEORGE BURKITT, trading as V. G. Burkitt & Co., 38, Park Row, Bristol, electrical engineer.—The application for discharge of this debtor was heard on February 29th at the Guildhall, Bristol. It appeared that the receiving order was made in February, 1911, when a dividend of 4s. 1d. in the £ was paid on liabilities of £215. Debtor commenced business in May, 1908, without capital, and he attributed his failure to bad debts and want of capital. The discharge was granted subject to debtor's consenting to judgment for £30.

G. E. HARRIS, plumber and electrical engineer, 14, North Street, Emsworth.—Trustee, Mr. H. B. Morris, Pearl Buildings, Commercial Road, Portsmouth, appointed February 29th.

J. BAKEWELL, electric light and power engineer, 43, Waterside Road, Barton-on-Humber, Lincolnshire.—Last day for proofs for dividend March 19th. Trustee, Mr. J. F. Wintringham, St. Mary's Chambers, Great Grimsby.

C. WRIGHT and H. T. WRIGHT, electrical engineers, 251, Fulham Road, S.W.—First dividend of 2s. 6d. in the £ payable March 19th at the offices of Messrs. Martin, Farlow & Co., 30, Gresham Street, E.C.

C. WRIGHT (separate estate).—First and final dividend of 20s. in the £ payable March 19th at the offices of Messrs. Martin, Farlow & Co., 50, Gresham Street, E.C.

H. T. WRIGHT (separate estate).—First and final dividend of 20s. in the £ payable March 19th at the offices of Messrs. Martin, Farlow & Co., 50, Gresham Street, E.C.

WILLIAM APPLEYARD BEAUMONT, 44, Warrengate, Wakefield, Yorkshire, electrical engineer.—The receiving order in this matter was made on February 15th, on debtor's own petition. The first meeting of the creditors was held on February 29th, at the Official Receiver's office, 21, King Street, Wakefield, when the case, being a summary one, was left with the Official Receiver as trustee of the estate. The following are creditors :—

	£		£
E. G. S. Co., Ltd.	21	Mrs. J. Beaumont	50
Watmough & Co.	138	— Fletcher	101

H. FARNELL, plumber and electrician, 183, Higher Hillgate, Stockport.—Last day for proofs for dividend March 22nd. Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester.

P. RUKIN, electrical engineer, Manchester Road Station, and 18, Mumford Street, West Bowling, Bradford.—Last day for proofs for dividend March 21st. Trustee, Mr. J. Draper, 69, Swan Arcade, Bradford.

W. P. YOUNG (W. P. Young & Co. & Leicester Tanning Machinery Co.), mechanical and electrical engineer, 40 and 42, Sanvey Gate, Leicester.—Last day for proofs for dividend March 21st. Trustee, Mr. T. F. Birch, Court Chambers, Friars Lane, Leicester.

Company Liquidations.—J. E. LESTER & FOLWELL, LTD., electrical engineers, &c., 60, London Road, Leicester.—The creditors interested herein were called together recently at the offices of the Leicestershire Trade Protection Society, New Street, Leicester, when Mr. H. T. Millman, the liquidator in the voluntary liquidation of the company, submitted a statement of affairs, which showed ranking liabilities of £5,119, of which £3,085 was due to the trade, and £2,034 was in respect of a bank overdraft. There were also fully secured creditors for £10,613, the securities held being valued at £11,300. After allowing £400 for preferential claims, the assets were estimated to realise £3,701, or a deficiency as regarded the creditors of £1,418. It was reported that the company was registered on February 15th, 1916, with a nominal capital of £10,000, divided into ordinary shares of the face value of £1 each. The issued capital was £5,472, and as regarded the shareholders there was a deficiency of £6,890. During the first four or five years the company traded successfully, and in 1920 a profit was made of approximately £1,000. The company purchased its present premises in July, 1920, at a cost of £5,250, and a considerable sum was spent on alterations and additions. The premises were mortgaged, and the mortgagees had given notice calling in the advance. The company was unable to comply, and that fact appeared to be the chief reason for the present position. The creditors passed a resolution confirming the voluntary liquidation of the company, with Mr. Millman as liquidator, while an advisory committee of three of the principal creditors was also appointed.

GODDARD, LAWRANCE & CO., LTD., electrical engineers and contractors, 28, Palmerston Road, Boscombe, Bournemouth.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was held on February 29th, at the offices of Mr. F. J. Webb, accountant and auditor, 1, Yelverton Road, Bournemouth. In the circular calling the creditors together it was stated that the company had passed the usual resolution in favour of voluntary liquidation, and had appointed Mr. Webb to act as liquidator. It was reported by the liquidator that the ranking liabilities totalled £3,242, whilst after allowing for the preferential claims, the assets were estimated to realise £3,035, or a deficiency so far as the creditors were concerned of £207. The company was registered on May 10th, 1923, with a nominal capital of £3,000, all of which had been issued for cash, and was fully paid. No figures were submitted showing the trading of the company since its incorporation, but it was understood that there had been a net loss up to the date of the liquidation of approximately £1,500. The directors attributed the present position to depression in trade, whilst the company had also been over-stocked. In answer to questions, the liquidator stated that since his appointment he had been endeavouring to dispose of the business as a going concern. Inquiries had been received, and he was in hopes of being able to dispose of the business at a price which would allow of a substantial dividend being paid to the creditors. A resolution was passed confirming the voluntary liquidation of the company, with Mr. Webb as liquidator, while an advisory committee of three of the creditors was also appointed. The principal creditors are :—

	£		£
Lawrance, G. F.	1,000	Western Electric Co., Ltd. ...	83
Brown Bros., Ltd.	198	Metropolitan-Vickers Electrical Co., Ltd.	185
Cable Accessories Co.	157	Marconi Wireless Telegraph Co.	275
Conradi & Braun	229	Amplifiers, Ltd.	72
General Electric Co., Ltd. ...	140		
Adlets, Ltd.	76		

SWARREN, LTD., London, W.C.—The liquidator has applied for his release. The receiver for the debenture holder reports that the amount realised, including the moneys received in respect of the unpaid calls and the uncalled liability on certain shares was only sufficient to make a payment on account to the debenture holder. There is therefore no prospect of funds becoming available for distribution to the creditors or shareholders.

FRANK CRAFT (CASTLEFORD), LTD., Central Chambers, 56a, Carlton Street, Castleford.—The winding-up order in this matter was made recently. The first meeting of the creditors was held on March 3rd, at the Law Institute, 1, Albion Place, Leeds. The following are creditors :—

	£		£
G. H. Armstrong	28	New Pelapone Engine Co., Ltd.	143
British Engine Boiler Insurance Co., Ltd.	18	P.O. Telephones	20
T. Beadle & Co., Ltd.	60	C. H. Parsons, Ltd.	18
Bradford Armature Winding Co.	12	Sun Electrical Co., Ltd.	32
Central Garage (Wakefield), Ltd.	26	Steel Tubes & Conduits Co. ...	23
Dorman & Smith, Ltd.	28	George Burn, Ltd. (Smethwick Tube Co.)	479
Dunning, Kay & Armstrong ...	59	H. W. Smith & Co., Ltd. ...	56
Electrical Conduits, Ltd.	29	J. H. Tucker & Co., Ltd. ...	54
Edison Swan Electric Co., Ltd.	55	Union Cable Co., Ltd.	129
English Electric & Siemens Lamp Co., Ltd.	246	Walsall Hardware Manufacturing Co., Ltd.	18
Electrical Specialities Co., Ltd.	309	Williamson, Henderson & Co. ...	87
Fitter & Poulton, Ltd.	341	Wynne & Smith	47
Foster Engineering Co., Ltd. ...	16	Z Electric Lamp & Supplies Co., Ltd.	2,472
Falk, Stadelmann & Co., Ltd.	26	Ezra Taylor	27
W. T. Glover & Co., Ltd. ...	306	George Hogley	32
W. Greenwood & Sons	14	A. E. Short	303
T. Hirst & Sons	20	Central Garage (Wakefield), Ltd.	57
Frank Kent & Co.	35	Income tax	280
T. Leafe & Sons	14	A. E. Short	50
W. Lucy & Co., Ltd.	36	Wages for workmen	49
T. B. Morley & Co., Ltd. ...	256	Health & Unemployment Insurance	68
R. Nicholson, Ltd.	23		
National Gas Engine Co., Ltd. ...	82		

PREMIER ENGINEERING CO., LTD.—A meeting of members is called for April 17th, at 1, Melbourne Street, Stalybridge, to hear an account of the winding-up from the liquidator, Mr. C. H. Mellor.

Dissolutions of Partnership.—CREWE, ALLEN & CO., electrical and mechanical engineers, 23 & 25, Chapel Street, Cripplegate, E.C.—Mr. H. T. Crewe and Mr. E. Allen have

dissolved partnership. Mr. Allen will attend to debts and continue the business under the same style.

Lund & Spencer, plumbers and electrical engineers, Park Road, Bingley.—Messrs. F. S. Lund, H. Bairstow, and W. Spencer have dissolved partnership.

Trade Announcements.—Messrs. Langley & Cross, who have commenced business as radio and electrical engineers at 1, Westfield Road, Leeds, desire to receive catalogues.

Mr. A. V. Creasey, of Bramley, Leeds, is opening a branch of his electrical engineering and contracting business, with showrooms and works, at 54, High Street, Knaresborough.

The business of John M. Henderson & Co., Kings Works, Aberdeen, was converted into a private joint stock company (John M. Henderson & Co., Ltd.) on January 1st.

The Engineering Service Co. has commenced business at 17, Mawdsley Street, Bolton, and desires to receive catalogues and price lists.

Messrs. Ira Stephens, Ltd., Whitelands Tannery, Ashton-under-Lyne, have issued a useful guide to the selection of asbestos, belting, and other materials.

Messrs. Ercole Marelli & Co., Ltd., announce that the name of the company has been changed to Marelli & Co., Ltd. The registered office will continue to be at 19/20, Garlick Hill, E.C.4, and there will be no change in the conduct of the business. The change will avoid further confusion through the Christian name Ercole being taken as a surname.

Catalogues and Lists.—Engineering & Lighting Equipment Co., Ltd., Sphere Works, St. Albans, Herts.—An illustrated and priced pamphlet dealing with "Monax" lighting glassware.

Messrs. C. A. Vandervell & Co., Ltd., Acton, London, W.1.—Illustrated and priced leaflet describing a new anti-dazzle lamp bulb for motor cars, which contains normal and dimming filaments.

Messrs. Siemens & English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4.—A large British Empire Exhibition poster with a symbolic border and a view of the Palace of Engineering, advertising "Siemens" lamps.

The Hendon Electric Lamp Co., 104, Southampton Row, W.C.1.—Showcards in attractive colours, with a box of "Spot-o'-Lites" attached to them.

British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2.—A folder advertising "Type B.4" radio valves. Illustrated and priced. Also incandescent Lamp Handbook No. 3d, giving full details of the correct lamps to use with various makes of automobile.

Messrs. John J. Griffin & Sons, Ltd., Kemble Street, Kingsway, W.C.2.—A leaflet describing a new high-resistance glass for chemical laboratories.

The English Electric Co., Ltd., Queen's House, Kingsway, W.C.2.—An illustrated brochure describing in some detail the "English Electric" camshaft control for motor-coach trains.

Swedish General Electric, Ltd., 5, Chancery Lane, W.C.2.—An illustrated pamphlet containing details of a new type of overload time-limit relay.

Messrs. Drew, Clark & Co., Leyton, N.E.—List No. K199, containing illustrations and prices of ladders of many types, trucks, &c.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—Special Publication No. 7,474/1, describing steam-operated air ejectors. Leaflet 304/2-1, dealing with earthing switches and resistances; and Leaflet No. 304/3-1, containing particulars of earthing connections and earthing testing panels.

Book Notices.—"Sell's Directory of Registered Telegraphic Addresses, with Telephone Numbers." (Pp. xxviii + 2,940 + 11.) London: Business Dictionaries, Ltd. Price 45s.—The thirty-ninth edition of this useful work of reference is of large proportions and is good value for money both in this respect and as a means of reducing the cost of telegrams. The form of the directory is too well known to need description, but it may be mentioned that nearly 130,000 firms in Great Britain and Ireland are included in the lists.

"The *Journal* of the South African Institution of Engineers." February, 1923. Johannesburg: The Institution. Price 2s. In this issue are reproduced papers on "A Carbon-Monoxide Detector and Alarm," by J. A. Vaughan; and "The Consumption of Lubricating Oil on Turbines," by W. O. Andrews.

"The *Journal* of the Junior Institution of Engineers." March, 1924. London: Percival Marshall & Co. Price 2s.—The principal papers which are reproduced in this issue are:—"Reinforced Concrete Engineering," by C. O. Mourant; "The Liability of an Employer in respect of Personal Injuries to his Workmen," by G. F. Tyler; and "Molecular Attraction and its Relation to Engineering," by Professor E. Edser.

"Principles and Practice of Telephony," by J. G. Mitchell. Vol. 1, "Circuit Refinements and Mechanical Switching," pp. vii+329; figs. 37; Vol. 2, "Mechanical Switching," pp. vii+263; figs. 31. Price 12s. 6d. each. London: McGraw Hill Publishing Co., Ltd.

The McGraw-Hill Publishing Co., Ltd., has issued a list of books on electrical engineering containing the titles, prices, and brief *résumés* of contents of about 130 works upon all branches of the subject.

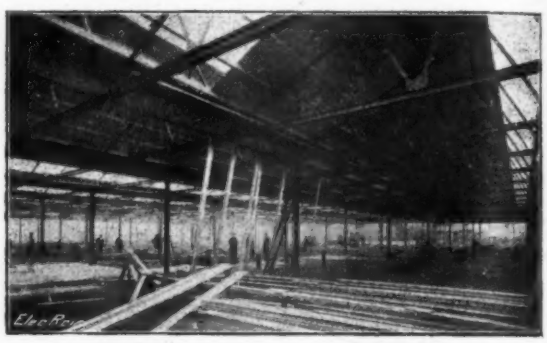
"Swoope's Lessons in Practical Electricity," by H. N. Stillman and E. Hausmann. pp. xiii + 625, 488 figs. London: Geo. Allen & Unwin. Price 12s. 6d.

"Direct Current Dynamo and Motor Faults," by R. M. Archer. Pp. x+204; figs. 75. London: Sir Isaac Pitman and Sons. Price 7s. 6d. net.

Correction.—In our last issue the date of the *Transactions* of the South African Institute of Electrical Engineers was inadvertently given as December, 1922, instead of 1923.

London Stock of Switchgear.—A few months ago Messrs. William Sanders & Co., Wednesbury, found it necessary to carry a stock in London of their various types of ironclad switch-and-fuse gear. Accordingly they left their offices in Charing Cross Road and took over more suitable premises at 128, Shaftesbury Avenue. There they have a representative stock of their products. The gear available ranges from the "Mite" type of ironclad fuseboard for from 5 to 10 amp. to "Superior" switches capable of dealing with 250 amps. or more. The latter are of the quick make and break type, and the switch blades are made up in parallel pairs to reduce arcing. The whole of the gear is built up on the mica-iron principle, which gives a sound and safe construction.

New Motor Factory.—Messrs. Higgs Bros. are erecting a new factory at Witton, Birmingham, for the express purpose of manufacturing motors up to a weight of one ton. The



Messrs. Higgs Bros.' New Factory.

building is approximately square, with one permanent wall only, so that extensions can take place on three sides; it is north-lighted, and there are no outbuildings. A view of the work in progress is given herewith.

Scottish Electricians' Wages.—A conference in Glasgow between representatives of the Electrical Contractors' Association of Scotland and of the Electrical Trades Union recently considered an application for an increase of wages by 2½d. per hour. A settlement was effected on the basis of 1d. increase payable on and from the pay day for the week ending March 15th, and the contractors also agreed to recommend to their members a further increase of ½d. per hour on and from the pay-day for the week ending May 3rd. If this ½d. is agreed to it will carry with it the stabilising of wages on that basis until the end of the year.

British Trade-Mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month of the dates mentioned. In the case of foreign applications, the names and addresses of the British representatives are also given:—

Mexamp. No. 437,121. Class 8.—A low-frequency inter-valve transformer for wireless telephone sets. The Beaufoy Electrical Co., 675, High Road, Tottenham, N.17. February 27th, 1924.

Harmotone. No. 441,661. Class 8.—Detector crystals for wireless telephonic apparatus. Edwin J. Dickson, 4, Byron Road, Walthamstow, E.17. February 27th, 1924.

Aristocrat. No. 443,754. Class 8.—Instruments and apparatus for use in wireless signalling. General Radio Co., Ltd., Twyford Abbey Works, Acton Lane, Harlesden, N.W. February 27th, 1924.

Monotrol. No. 442,898. Class 8.—Wireless telephonic receiving sets. The Sleeper Radio Corporation, 88, Park Place, New York, U.S.A. (White, Langner, Stevens & Parry, 88-90, Chancery Lane, London, W.C.). February 27th, 1924.

Bambairtite. No. 443,998. Class 8.—Cells for electric batteries. Charles K. Bamber, 9, Victoria Street, London, S.W. February 27th, 1924.

Durabit (lettering and design). No. 442,883. Class 50.—Electric insulating tapes composed of a textile material impregnated with india-rubber. Kraupy & Schönmann Kabel Isolier Band und Gummiwaren Erzeugung "Durabit," 5, Zollergasse, Vienna, VII, Austria (Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.). February 27th, 1924.

Standard Types and Production Costs.—The possibility of reducing the cost of production of Swedish goods is being eagerly studied. Among the measures aiming in this direction was the fixing last year of sixty standard types for engineering products.—*Reuter's Trade Service* (Stockholm).

Austrian Company.—The Oesterreichische Dampfturbinen A.G. is about to go into liquidation. It was founded in 1902 by the Erste Brünner Maschinenfabriks Gesellschaft in conjunction with the Parsons Foreign Patents Co., Ltd., London.

The Labelling of Parcels.—Should manufacturing and wholesale firms label parcels with the full place of origin? The question, of interest to electrical dealers, arose at a Blackburn tradesmen's meeting, on March 6th, when it transpired that persons handling parcels in course of transit had endeavoured to secure supplies by writing direct. It was stated that railway companies preferred to have the sender's name and address clearly indicated to guard against the consignee's particulars being inaccurate. The meeting thought a better arrangement should be made whereby a firm's identity was not revealed. One delegate suggested a code system to which the railway clerical staff alone should have access.

Electricians' Wages.—The Birmingham Electric Supply Committee has under consideration an application from the operative electricians for a wage increase of 10s. weekly.

Waring & Gillow's Electrical Exhibition.—An excellent display of electrical apparatus and fittings has been arranged by the Electrical Department of Messrs. Waring & Gillow, Ltd., Oxford Street, W.1, in conjunction with a number of well-known electrical firms. In the rotunda on the ground floor is a representative collection of domestic appliances, including many "Universal" kettles, irons, percolators, grills, &c. (Messrs. L. G. Hawkins & Co., Ltd.); "Magnet" irons and bowl fires, and "Osram" colour-sprayed lamps (The General Electric Co., Ltd.); "Cosmos" fires, irons, kettles, &c., and "Radiobrix" radio apparatus (Metropolitan-Vickers Electrical Co., Ltd.); "Thor" washing and ironing machines, "Superior" washers and vacuum cleaners (Hurley Machine Co.); "Belling" fires; and "Sterling" radio sets.

In addition to this heterogeneous collection, the firm has arranged an "All-Electric Home" on the second floor, consisting of a dining room, sitting room, kitchen, main bedroom, two spare bedrooms, bathroom, and a maid's room. In each of these rooms appear appropriate electrical appliances. In the bathroom is a "Benham" towel rail, a "Bastian" geyser, shaving pot, vibrators, &c. The kitchen is equipped with "Tricity" and "Jackson" cookers, which are demonstrated, a "Thor" washer, a grill, irons, &c. In the dining room are a "Magicoal" fire and numerous small appliances as toasters, percolators, grills, &c.

The exhibition should prove of great educative value to the many visitors to Messrs. Waring & Gillow's showrooms, and good results are anticipated.

Battery Prices Advance.—The Hart Accumulator Co., Ltd., announces that, owing to increased cost of raw materials, the prices of all its portable batteries for wireless and motor-car starting and lighting work were advanced on March 1st.

Whitley Councils in South Africa.—On March 4th the Union House of Assembly passed the third reading of the Industrial Conciliation Bill, which provides machinery for the avoidance of industrial disputes by the Whitley Council system and the settlement of disputes in industries which do not avail themselves of that system by the appointment of *ad hoc* conciliation boards. The Bill carries out the recommendations of the Brace Commission, which was appointed after the Rand strike disturbances of 1922.—*Reuter* (Cape Town).

Copper and Lead: Production and Prices.—In connection with our editorial comments this week on this subject, the following tables showing the world's production of copper and lead during recent years will be of interest:—

	Copper.	Lead.	
1913	973,365	1,172,195	metric tons.
1914	918,268	1,155,349	,,
1915	1,078,187	1,107,451	,,
1916	1,391,365	1,138,459	,,
1917	1,433,450	1,170,856	,,
1918	1,424,182	1,195,533	,,
1919	970,386	885,251	,,
1920	978,371	861,094	,,
1921	836,417	867,834	,,
1922	895,895	1,042,639	,,

Annual average prices per ton over the past 10 years are given below:—

	Electro-Copper.			Lead.		
1914	£62	5	6	£18	13	9
1915	84	2	7	22	17	8
1916	138	0	10	30	19	6
1917	136	8	10	30	0	0
1918	128	5	10	30	2	8
1919	100	15	1	28	3	11
1920	110	10	0	38	4	7
1921	75	1	1	22	14	6
1922	69	9	3	23	14	10
1923	72	11	3	26	16	4

Recent Contracts.—Among the larger orders which have recently been placed with the Relay Automatic Telephone Co., Ltd., the following may be mentioned:—Private branch exchanges for the G.P.O. at the Banque Belge (London), Scottish Oils, Ltd. (Glasgow), Ward & Goldstone, Ltd. (Manchester), Burndept, Ltd. (Blackheath), and the Perth Royal Infirmary. Recent private installations include:—The Westminster Bank (London), John Foster & Sons, Ltd. (Queensbury, Yorks.), Edinburgh Royal Asylum, and Richard Thomas and Co. (London). Among orders for extensions is one from Poona for the enlargement of the public exchange. The company's French licensees have recently installed a public exchange at Bihorel, near Rouen.

The Fair and the Exhibition.—The organisers of the British Industries Fair state that misapprehension still exists in the minds of many traders as to the relative positions of the Fair and the British Empire Exhibition. The two events are in no way connected, except that they have in common the object of advancing British trade and interests. The Fair is purely a traders' organisation, designed to acquaint actual buyers with the excellence of British goods. On the other hand, the Exhibition is open to the public, and the principal motive behind it is the education of the public in the ideas of "Empire," as well as to impress foreign visitors with the position which the British Empire holds in manufacturing production and world affairs.

New Australian Companies.—The following new companies were registered in Sydney in January:—Colville-Moore Wireless Supplies, Ltd. Capital, £7,500, in £1 shares, to carry on the business of wholesale and retail traders in wireless and electrical apparatus.

Australian Westinghouse Electric Co., Ltd. Capital, £25,000, in £1 shares, to carry on the business of electricians and mechanical and electrical engineers, metallurgists, and metal and iron workers.

For Sale.—Salford Corporation Electricity Department invites offers for several 440-volt d.c. motors and starters, of 10 to 53 h.p.; East Ham Borough Council Electric Lighting and Tramways Department has for disposal one 350-i.h.p. horizontal cross-compound engine, direct-coupled to a 225-kW generator. Birmingham Corporation Electric Supply Department invites offers for the a.c. generating plant installed at the Chester Street generating station. (See our advertisement pages to-day.)

New Showrooms.—The accompanying illustration is a view of part of new showrooms opened at Quality House, Temple Row, Birmingham, by Messrs. Walker Bros., electrical engineers. These showrooms are in an imposing building, and, as will be seen from the illustration, are very well laid out with electrical fittings and appliances for domestic use, as well as radio equipment.

Messrs. Walker Bros.' New Showrooms.

Copper and Lead Prices.—Messrs. F. Smith & Co. report March 11th:—Copper (electrolytic) bars, £74 5s., 5s. increase; do. do. sheets, no change; do. do. wire rods, £84 5s., 5s. increase; do. h.c. wire, 10¼d., 1-16d. increase.

Messrs. James & Shakespeare report March 12th:—Copper bars (best selected), sheet and rod, no change; English pig lead, no change.

The Situation in Germany.—According to the reports of the Prussian Chambers of Commerce for February, the situation of business in electrical manufactures in the inland market in that month perceptibly improved, but export transactions slightly declined. Most of the works availed themselves of the award giving the possibility of introducing the nine hour shift. The high railway rates in force increase the costs of production, and the recent reduction in rates, which is considered to be inadequate, has as yet failed to bring about favourable results. On all hands the scarcity of capital has an unfavourable influence.

Dundee and Cable Tenders.—The Dundee Corporation Electricity Committee recently considered tenders for cable, and in a case where the difference in price of foreign and British cable was only £23 it was agreed to accept the British tender. Considerable debate took place, however, over an offer where the quotation for foreign cable was £176 less than the lowest British offer. It was left to the convener and the engineer to decide.

Local Exhibition.—PRESTON.—The Electricity Committee on Monday last inaugurated an electrical exhibition. One of the features of the exhibition is an all-electric house, containing a large assortment of domestic appliances, from electric kettles and sewing machines to cookers and radiators. Local manufacturers and contractors have supported the exhibition on a generous scale. Each day demonstrations in electric cooking have been given. The exhibition concludes to-day (Friday).

Spanish Companies.—There has been formed at Bilbao (14 Concha) the Construcciones electro-mecanicas "Unibaso" for the construction and sale of machinery and electricity. The capital is 400,000 pesetas.

With the view of acquiring the gas and electricity works and other assets in Almeria of the Sociedad Lebon y Companhia, an extraordinary meeting of the Fuerzas Motrizes del Valle de Lecrin sanctioned the raising of 3,000,000 pesetas of additional capital.

Henley's Dramatic Club.—The revival of amateur theatricals is a very welcome feature of the social tendencies of the present time. Dramatic clubs afford an opportunity for the discovery and development of natural abilities and a means for enjoyment, which cannot be found in the more flippant and less profitable means of relaxation. Not all jaded minds find relief in the same kind of amusement, and most minds need variety. The formation of such clubs in connection with business houses is always to be highly commended, presuming there is somebody with the gift of production available. It contributes to the better atmosphere of any concern when the departmental partition walls of the day-time employment fall away and everybody from the office boy and the commissionaire to the directors mixes in one common company for a social evening, such as we were able to enjoy on Friday evening last at the Cripplegate Institute, Golden Lane, when Henley's Dramatic Club gave their third public performance. "The Magistrate" (Sir A. W. Pinero's farce) was well rendered in the presence of an audience of from 300 to 400, consisting chiefly of the staff and employés at Blomfield Street and their friends. Mr. Frank Bettley performed the part of Mr. Posket, the Magistrate, as to the manner born, and Mr. Robert K. Edney, as the under-aged young rascal, "Cis Farringdon," did well, but we must not single out more of the characters, because there were so many calling for praise. The only critical comment that we should feel disposed to pass would be the general observation that one hears at many such performances—how much better is the second night than the first, and the third than the second. Why not an interchange of performances between the clubs of different firms? We missed Sir George Sutton, the president of the club, who had a cold, but among the "patrons" present we noted Messrs. W. J. Potter, a director, and Mr. P. Rosling, the general manager of the company.

The Fulham Contract.—The following are further particulars relating to the contract received by Messrs. Vickers, Ltd., for the extension of the electric lighting plant for Fulham Borough Electricity Works (as mentioned in our last issue and in our "Contracts Closed" column to-day). There will be two 6,000-kW turbo-alternator sets, complete with boilers, condensers, pumps, piping, buildings and foundations. Everything, from foundations to roof, will be supplied by the Vickers organisation. The turbines and electric generators will be made by the Metropolitan-Vickers Electrical Co., Ltd.; the cables, &c., by W. T. Glover and Co., Ltd.; the boilers and stokers by Vickers-Spearing Boiler Co., Ltd.; the condensers, pumps, &c., by Vickers, Ltd., Barrow-in-Furness. Everything will be entirely of British manufacture, and, wherever possible, local unemployed labour will be used.

Tenders to the Sydney City Council.—The Sydney City Council was to have brought before it at one of its meetings in January a motion by Alderman Chas. Bridges, proposing that in view of the statements made "regarding the practice of the contractors to the Council increasing the amount of their tenders by a sum of money which, it is alleged, is afterwards divided between the unsuccessful tenderers as a consolation, the matter be referred to the proper committee with a view to having the allegations, as far as they affect the Council, fully investigated."

The Sydney *Sun* quotes another alderman as stating that certain tenderers agreed to increase the amount of their tenders proportionately, without regard to which was the lowest. In fact, the tenderers themselves did not know which was the lowest. The amount which each had agreed to increase his tender by, however, was divided among the unsuccessful tenderers. The *Sun* quotes from a report made to the City Council by Mr. Forbes Mackay, the electrical engineer, on tenders received for a storage battery. "The prices at which the largest size battery is offered by the three firms tendering," he states, "are the same in each case. The fact of the three tenders being for identical amounts, and the amounts in the case of the largest size battery being over £80,000, showed unmistakably that the firms tendering had been in consultation. The knowledge that this was so inclined me to recommend the Council to accept no tender, as there seemed to be a risk that the price asked was unreasonably high. I went the length of inviting the three firms which had tendered to send representatives to see me, and told them that I was not inclined to recommend the acceptance of any tender, because the three firms had obviously agreed among themselves on the amount of their tenders. Since then, however, I have made a number of inquiries, and have come to the conclusion that, while it is unsatisfactory to have tenders made for such a large contract by three separate firms in consultation one with another, the price at which the battery is offered is not unreasonable."

Prague Samples Fair.—We are informed that the forthcoming Samples Fair at Prague (March 16th to 23rd) promises to be well attended. The electrical group comprises the exhibits of 73 firms.

British Empire Exhibition Note.—THREATENED STRIKE.—The strike of electricians, upon a question of the employment of non-union labour at rates lower than the standard, which was to have taken place on Saturday last, was postponed on account of a partial settlement having been arrived at with the employers. A further meeting of the men is to be held to-day (Friday).

Lighting and Power Notes.

Aberdeen.—NEW PLANT.—The Town Council has approved a report submitted by the electrical engineer (Mr. J. A. Bell) on extensions to the sub-stations. It has been decided to install 1,000-kW motor converters, with the necessary switchgear, at two of the sub-stations at an estimated cost of £5,880 and £4,321 respectively.

Alton (Hants.).—PROPOSED ELECTRICITY SUPPLY.—The Urban District Council is to hold a special meeting to consider a proposal to erect a power station for the supply of electricity in the town.

Bangor.—PROPOSED CHANGE-OVER.—The Corporation has applied to the Electricity Commissioners for sanction to change the present system of electricity supply for the following:—A supply on the d.c. or a.c. system as may be found advisable in each individual case, (*a*) d.c. supply to be at 400 V for power and 200 V for lighting, (*b*) a.c. supply to be at 400 V for power and 230 V for lighting on the three-phase, 4-wire system at 50 cycles.

Bath.—ELECTRICITY AGREEMENT.—The Town Council has applied to the Electricity Commissioners for sanction to an agreement to supply electricity in bulk for consumption in West Wilts. to the Western Electric Distributing Corporation, Ltd. The terms are that the company shall pay £5 per kW of maximum demand, and at the end of the first five years make up any difference between the amount paid in respect of the maximum demand and £6,250. After that period it will pay a minimum of £1,250 a year and, in addition, .75d. per kWh supplied, subject to variation according to the price of coal. The terms of payment are to be subject to revision every seven years, and the agreement is to be in operation for 30 years from September, 1924, subject to determination by either party under certain conditions.

Blofield.—SPECIAL ORDER.—Application has been made to the Electricity Commissioners by the Brundall and District Service Co., Ltd., for a Special Order authorising it to distribute electricity within the parishes of Brundall, Blofield, and Witton, in the rural district of Blofield.

Brighouse.—LOAN.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £25,000 for mains.

Ceylon.—HYDRO-ELECTRIC DEVELOPMENT.—According to *The Times*, the Legislative Council of Ceylon has sanctioned the Aberdeen-Laxapana hydro-electric scheme. In the first stage of the development the scheme will yield at Colombo 10,000 kW at a capital cost of Rs.10,710,000, and is designed to cover an area having a radius of 25 miles from the city. In the second stage the scheme is expected to cost Rs.11,800,000 and yield 15,000 kW. In the third stage, when the transmission line and distribution services are planned to serve a tea and rubber manufacturing district of 50 miles radius round the generating station, it is expected to raise the output to 32,500 kW at a total cost of Rs.24,100,000. At the same time extensions are proposed to the towns of Chilaw and Puttalam in the north of the island, Kegalle and Polgahawela in the east, and Panadura, Kalutara, Tebuwana, and Ratnapura in the south. Of the estimated cost of the first portion of the scheme about Rs.6,000,000 will be spent in the United Kingdom in the purchase of the necessary plant. The expenditure in the course of the present year will probably amount to a million rupees.

Chesterfield.—ELECTRICITY SUPPLY.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £2,000 for the wiring of small houses.

A rotary converter, with e.h.p. switchgear, is to be installed at the electricity works at a cost of £1,700.

A canvass is to be made of residents on the Boythorpe estate to ascertain the demand for an electricity supply.

Continental.—JUGO-SLAVIA.—An electricity generating plant has recently been completed in connection with the collieries of the Société des Charbonnages d'Alexinatz.

BELGIUM.—La Société d'Electricité des Ardennes, of Liége, has secured the concession for the supply of electricity in the commune of Basse-Bodeux (Liége).

Glasgow.—PROPOSED NEW PLANT.—The Corporation electrical engineer, in the course of a report to the Town Council on the proposed installation of a 10,000-kW turbo-alternator set at the Pinkston tramway power station and also with regard to the question of the co-ordination of the city electricity supply system and the tramways, states that the systems of the two departments have been connected by transmission cables capable of carrying 10,000 kW, so that an interchange of current can be, and has been made. Regarding Dalmarnock, the installation of plant for the first half of the station, amounting to 100,000 kW, has now been completed and is in commission. The maximum demand during this winter was 81,600 kW. Orders have been placed for extensions to this plant, and, in 1925, a further 40,000 kW will be available. Another power station to be erected by the Corporation is under consideration. By shutting down Pinkston station at periods of light load there would be a direct saving to the Tramways Department. As regards rates, the engineer points out that the tramway manager has stated that he would be prepared to take a supply of electricity from the Electricity Department as soon as that could be done at a rate equal to the cost of generation by his own department. The Electricity Department is now in a position to quote favourable terms to the Tramways Department.

The manager of the Tramways Department, in his report, states that if the new set were installed at the Pinkston station the Tramways Department would save in coal costs alone over £18,000 per annum.

Messrs. F. H. Whysall, W. C. Bexon, and A. E. McColl, electrical engineers of the Burghs of Greenock and Kilmarnock and the Clyde Valley Power Co., recommend (1) That the Glasgow Corporation Tramways Department be permitted to install two sets to replace the existing 2,500-kW reciprocating engine-driven alternators, and additional plant to replace the earlier turbine plant as the load demands on the station increase. (2) That the Pinkston station be considered as one of the main generating stations for the electricity supply of the West of Scotland. (3) That the Canal Commissioners be approached with a view to inducing them to increase the quantity of inlet water to the canal. At a meeting of the Tramways and Electricity Joint Committee it was proposed that an electrical expert be appointed to report on the whole question, and this was agreed to.

Halifax.—LOAN.—The Tramways and Electricity Committee is applying for sanction to the borrowing of £101,325 for electricity extensions. The scheme includes £40,000 for an additional 10,000-kW turbo-alternator, £14,000 for condenser plant and l.p. switchgear, £9,000 for four cooling towers, £8,000 for the foundations of the towers, and £15,000 for land. The Electricity Commissioners have given their consent to the scheme.

Irish Free State.—ELECTRICITY BILL.—The Electricity Undertakings (Continuance of Charges) Bill was passed through the final Committee stage in Dail Eireann last week, only one verbal amendment being tabled, and the Report stage is fixed for the middle of March.

Japan.—HYDRO-ELECTRIC SCHEME.—By constructing a dam on the Shinano river, it is estimated that 250,000 h.p. can be developed. The plant, which will cost approximately seven millions sterling, will comprise sets of 28,000 h.p. each. The power will be utilised for the electrification of the railway between Tokio and Numadzu. The work is to be completed by the end of 1926.—*Indian Engineering.*

Leyton.—LOAN.—The Urban District Council has applied to the Electricity Commissioners for sanction to a loan of £5,500 for additional plant at the electricity works.

Llandudno.—SPECIAL ORDER.—The Town Council is applying to the Electricity Commissioners for a Special Order authorising it to extend its area of supply so as to include the Rural District of Conway and the parish of Penrhyn.

The Electricity Committee has offered a supply of electricity to the London, Midland & Scottish Railway Co., at a net charge of 3d. per kWh for a minimum supply of 20,000 kWh per annum, for the lighting of the Llandudno station premises.

Lytham-St. Annes.—LOANS SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £50,000 for mains, £6,500 for converter plant, and £8,250 for meters.

London.—HAMPSTEAD.—The Borough Council is to improve the street lighting in the borough by substituting 60- and 100-watt gasfilled sprayed-type lamps in place of the existing 40-watt vacuum type.

WOOLWICH.—A breakdown occurred at the Council's power station on March 1st at 9.30 p.m., and a number of the main streets were in darkness. The electricity supply was resumed shortly after 9.50 p.m.

Preston.—ELECTRICITY CHARGES.—The Electricity Committee has decided that from April 1st next the proposed two-part tariff for private houses shall consist of a fixed charge equivalent to 20 per cent. on the rateable value of houses assessed at £15 and upwards, with a minimum charge of £3 per annum, and the minimum number of kilowatts installed according to the scale now submitted, plus a running charge of 1d. per kWh for electricity consumed for any purpose, the Committee to be empowered to vary the basis of the fixed charge in special cases, the "unit" charge to be subject to 10 per cent. discount for payment within 21 days. It has also been decided that a charge of 1½d. per kWh be made for supplies through a separate meter, for heating and cooking, with a discount of 10 per cent., for prompt payment of accounts.

LOAN.—Application is to be made to the Electricity Commissioners for sanction to the borrowing of £1,000 for cookers and fires.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

ROCHESTER.—*The Kent Electric Power Co.*—Lighting: 7½d. per kWh.

LONDON.—*Chelsea Electricity Supply Co., Ltd.*—Lighting: 7d. per kWh.

WOKING.—*Woking Electric Supply Co., Ltd.*—Lighting: From 9d. to 8d. per kWh.

ST. ANDREWS (FIFE).—*Electric Supply Corporation, Ltd.*—Lighting: From 10d. to 9d. per kWh.

BUXTON.—Lighting: Under 200 kWh per quarter, from 9½d. to 8d. per kWh; 200 kWh and over, from 8½d. to 7d. per kWh. Heating and cooking: From 3½d. to 3d. per kWh. Power: Under 1,000 kWh per quarter, from 3d. to 2½d. per kWh; 1,000 kWh and over, from 2½d. to 2d. per kWh.

Sheffield.—SPECIAL ORDER.—The Corporation has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of supply so as to include certain parishes in the rural districts of Norton and Chesterfield.

Stalybridge.—NEW STATION.—The Joint Tramways and Electricity Board for Mossley and Stalybridge has received formal consent from the Electricity Commissioners to the establishment of a new generating station at Hartshead. Approval of the borrowing of £150,000 for the new generating station and £10,000 for h.p. mains has been received. The Board is (1) to proceed without delay with the erection of the new generating station at Hartshead; and (2) has instructed the engineer to proceed with the laying of the mains.

Ticehurst (Sussex).—ELECTRICITY SUPPLY.—The Rural District Council has consented to an application by the promoters of the Cranbrook-Tenterden electricity scheme to include the area of the Council. The promoters are to obtain a supply of electricity from the Tunbridge Wells Corporation, and, if necessary, a central station will be erected at Hawkhurst.

Walton-on-the-Naze.—PROPOSED NEW PLANT.—The electrical engineer has recommended the installation of a 100-kW generating set at the electricity works, and the Council has decided to obtain the advice of Mr. E. W. Dorey, consulting engineer.

West Riding (Aire and Calder) Electricity District.—OFFICERS RE-ELECTED.—A meeting of the local authorities, comprising what is known as "the Conference" in the West Riding (Aire and Calder) Electricity District, was held at Bradford on March 3rd, when the following officers were re-elected:—Chairman: Ald. Wilfred Turner (chairman of the Bradford Electricity Committee); solicitor to the Conference: Mr. N. L. Fleming (Town Clerk of Bradford); Executive: Alderman W. Turner (Bradford), and Messrs. T. Hey (Halifax), Shires (Huddersfield), and Kilburn (Dewsbury). Mr. Fleming was appointed chairman of the Solicitors' Committee; Mr. Thos. E. Roles (Bradford city electrical engineer), chairman of the Engineers' Committee; and Mr. F. Ogden Whiteley (Bradford city treasurer), chairman of the Financial Officers' Committee.

Tramway and Railway Notes.

Bradford.—RAILLESS CARS.—The Tramways Committee has considered the report of a deputation to Birmingham to inspect the railless car system there, and has decided that on powers being obtained, an experimental railless car service shall be run along the existing Lidget Green tramway route from the city, and to Clayton, which at present has no service. If the experiment is successful the method will probably be extended to other routes.

Continental.—SWEDEN.—An inquiry is to be instituted on private initiative regarding the possible electrification of ten railways in middle Sweden, including the important Bergslagen lines and certain other lines terminating at Gothenburg.—*Reuter's Trade Service* (Stockholm).

ITALY.—La Società delle Ferrovie del Ticino is in negotiation with the Società Ricostruzione e Sviluppo Trasporti della Provincia di Alessandria for the taking over of its railway between Vercelli and Casale, which it is proposed to electrify and to connect up with the State railway system.

Darwen.—NEW CARS.—The Corporation is to purchase two new top-covered tramcars.

Leeds.—Proposed Light Railway.—The Tramways Committee has recommended to the Corporation the purchase of land adjoining the Middleton Estate and Colliery Co.'s mineral line between Burton Row, Hunslet, and Great Wilson Street, required in connection with the construction of the Middleton Light Railway, at a cost of £24,000.

Liverpool.—New Cars.—The Corporation is to construct 36 new tramcars at the Lambeth Road works, at a cost of £50,000.

London.—New Cars on the "Underground."—Two hundred cars of an entirely new design will be put into service between Hendon and Moorgate when this new route opens next month. In these cars are embodied the principal features of the six experimental cars which were constructed by separate makers and entered for the Underground competition in 1922. Six of these latest-type carriages are now in daily service upon the Hampstead line, and deliveries are being made rapidly of the remaining cars.

L.C.C. Car Improvement.—The London County Council is to experiment with spring seating on the tramcars.

Morocco.—Railway Electrification.—Up to the present time the electric energy needed by the chief towns of Morocco, Casablanca, Rabat, Fez, &c., has been supplied by local power stations. Now, however, it is intended to electrify the normal-gauge railway, which is gradually replacing the old 60-centimetre line laid down by French Army engineers. A power station which will have a capacity of 18,000 kW is being erected at Casablanca, and it is hoped that it will be working by the end of the year. The current will be transmitted from the station at 60,000 V, and will be transformed by the railway company to d.c. at 3,000 V. The same system will supply towns, which will take electrical energy direct from the Casablanca station and reduce the voltage for local use. It is intended to run h.p. transmission lines to Kenitra and Marrakesh, and those to the latter city will be utilised when the normal-gauge railway between Casablanca and Marrakesh is opened in 1926. The Rabat-Casablanca railway will, it is hoped, be electrically operated in a year's time.—*Reuter* (Paris).

Pontypridd.—New Route.—The tramway manager has recommended to the Town Council that the tramway service be extended to Rhydfelen at an estimated cost of £9,000.

Rotherham.—Weekly Tramway Passes.—The Tramways Committee has recommended the Borough Council to adopt the weekly tramway pass system on all routes within the borough, the tickets to be sold at a reduction of 25 per cent. on the ordinary fares.

Southern Railway.—Electrification Schemes.—Addressing the shareholders at the annual meeting of the Southern Railway Co. on March 7th, Sir Hugh Drummond (chairman) said that apart from the electrification of the suburban lines of the South-Eastern section, it had been decided to carry out the electrification of the Brighton section as far as Sutton, and extension to Epsom was being considered. On the South-Western section the electrification area was being extended from Surbiton to Guildford, *via* the Cobham line, and from Raynes Park to Effingham Junction, *via* Leatherhead, and from Leatherhead to Dorking. It was hoped to have all this work finished by the end of next year, and its completion would leave the Southern Railway in possession of a larger electrified route mileage than all the other railways in the kingdom put together. It had been proved on the Brighton system that electrification brought about an increase of traffic; equally good results were expected upon the South-Eastern section.

Telegraph and Telephone Notes.

Canada. — Telegraph Rate Reduction. — The Canadian National Telegraphs announce a rate reduction which was to come into effect on March 9th of four cents per word to the Prairie provinces and British Columbia, both in respect of the regular and preferred cable rate. This follows the reduction recently given to Manitoba and the East.—*Reuter.*

Railway Telegraphs.—The Teletype.—We learn that the Great Western Railway Co. has recently adopted on its London-Birmingham telegraph system teletype apparatus in place of the old sound instruments. By means of the new machines it is stated that a typist after a little practice is able to transmit messages at the rate of 40 words per minute.

Russia.—New Radio Stations.—The daily Press announces that 200 radio stations are to be established in Soviet Russia in the near future.

Telegraphy and Telephony in the Army.—Radio Equipment.—In connection with the Army Estimates for 1924-25, the Secretary of State for War last week issued a memorandum, in the course of which it is stated that progress has been made in the design and supply of radio equipment for signal communication and small portable radio telegraph sets using continuous waves are now in use. Experiments in the use of radio telephony for communication with aeroplanes and tanks on the move are very promising and will enable closer co-operation to be maintained. Practical experience during the last year's training, however, showed that it is not yet possible to rely entirely on radio for signal communication in the army and that to some extent field cables must be retained in the Signals establishments. At the Research Department at Woolwich research in connection with engineer stores is being directed to the perfecting of radio telegraph and telephone equipment.

Turkey.—Telegraphic Delay.—The Eastern Telegraph Co.'s offices at Constantinople were sealed by the police on March 2nd on the technical ground of non-compliance with the registration formalities. The company announced that traffic would be subject to heavy delay in consequence.—*Daily Mail.*

West Indies.—New Radio Stations.—As has already been announced a contract has been granted to the Radio Communication Co., of Great Britain, for the erection and equipment of a chain of seven high-powered radio stations on the islands of the crescent-shaped archipelago which flanks the Caribbean Sea. Private enterprise, says the *Manchester Guardian*, is to be confined to the erection, equipment, and initial testing. The stations are to be operated by the Pacific Cable Board and the contract cost is £62,670, which is shared by the Colonies concerned and the Canadian and Imperial Governments.

New Cable.—A memorandum on a financial resolution was issued by the Treasury on March 8th. The resolution, says the *Financier*, is proposed in order to enable a Bill to be introduced providing that a sum not exceeding £400,000 may be issued from the Consolidated Fund for the construction of a new submarine cable from Turks Island, where it will join the existing cables of the Direct West India Cable Co. to Barbados, and for the provision of telegraphic communication between Barbados, Trinidad, British Guiana, St. Kitts, Antigua, Dominica, St. Lucia, St. Vincent and Grenada. The amount advanced will be repaid by an annuity for a term not exceeding 30 years. It is anticipated that receipts will normally exceed expenses, other than the annuity, by about £8,000, and the actual charge on the Exchequer is not likely to exceed £5,500 a year. Against this there will be a saving of £8,000 a year, as the subsidy now paid to the West India and Panama Telegraph Co. will cease.

French Cable Cession.—With regard to the proposed cession of the cable linking New York with the West Indies and with certain towns of Central and South America by the Compagnie Française des Cables Telegraphiques to the All-America Cables (Inc.), at an extraordinary meeting of the shareholders of the French Company the board of directors showed that various conventions concluded with the Colonies and the countries through which the cable passed, giving the company special privileges and monopolies, would lapse in 1924, 1927, and 1929; thus the choice had to be made whether it would be better to carry on an unequal struggle against American competition or hand the system over to an American company. Negotiations were entered into, and a provisional agreement was arrived at, according to which the West Indies cable will be taken over by the All-America Cables as from January 1st, 1924, for a price in dollars varying from 2,235,000 to 2,735,000 dollars, according to the rate of exchange, and the American Company will undertake to hand over to the French Company at New York for transmission by its system all the traffic bearing no indication as to route, from the ceded lines formerly exploited without competition by the French Company. The transfer was agreed to by the shareholders, and it is understood that it has the approval of M. Laffont, Under Secretary of State for Posts and Telegraphs. The latter has also, according to a Paris newspaper, obtained the consent of the Departments interested—Foreign Affairs, Colonies, and Marine. The matter has been submitted to the Superior Council of Posts and Telegraphs, and will eventually be submitted to Parliament. M. Laffont has announced that a radio station will be erected on the Island of Martinique. According to the *Quotidien*, the Superior Council of Posts and Telegraphs is not in favour of the abandonment of the cable system, even if the cable had to be worked at a loss.—*Reuter* (Paris).

Radio Notes.

Broadcasting to America.—First Attempt.—The early hours of this morning were fixed for the first organised attempt of the British Broadcasting Co. to broadcast music to the United States and Canada. The transmission was to take place from the ballroom of the Savoy Hotel, and was to last from 1 a.m. to 2.30 a.m., on a wave-length of 365 metres.

Germany.—Possible Monopoly.—Reichstag support has been promised the Government for a measure to assume the monopoly of the radio telephone industry, both as regards manufacture of receiving sets and the control of broadcasting programmes. It is expected that a heavy luxury tax will be imposed on the better class of apparatus, and considerable revenue result, just as it has from the telephone monopoly.—*Financial Times.*

Licences.—B.B.C. Fees.—In a written answer to a question by Sir F. Wise, in the House of Commons, the Postmaster-General stated that on January 31st, 1924, about 696,000

radio-receiving licences were in force; figures for February were not yet available. The total amount actually paid to the British Broadcasting Co., Ltd., by the Post Office to date was £7,450; but, subject to Parliamentary sanction and to its obligation to return any ultimate surplus, as provided for in its last agreement with the Post Office, the total amount which the company would be entitled to receive in respect of the fees on those licences would be about £348,000. *The Times.*

It is understood that the B.B.C. receives one-twelfth of any sum due to it from licences once a month, always three months in arrear, so that it will not be paid the December amount until the end of March.

Relay Stations.—OPENING DATE.—It is understood that the B.B.C. relay station at Plymouth will be opened on March 26th, and that the inauguration of those at Liverpool and Edinburgh will follow very shortly.

Russia.—RUSSO-FRENCH AGREEMENT.—Between the French General Wireless Telegraph Co. and the Russian Electrical Trust of Weak Current Factories an agreement has been made, confirmed in September last year, by virtue of which the company named engages to lend the Trust technical assistance, both in the making of apparatus for radio stations and in organising radio-telegraphic production in Russia. In return for technical co-operation and assistance, the Trust will pay the Company a fixed percentage on all its returns obtained, either directly or indirectly, from all its radio transactions, with the exception of contracts to sell buildings, steam engines, or motors. The Company engages to sell to the Trust on credit all kinds of requirements for its manufacture, at the lowest prices, based on similar goods in contracts concluded between the Company and Government establishments during a period of time lasting twenty months. The duration of the agreement is five years, in fulfilment of which the Weak Current Trust has already received a number of drawings from the French Company. A special committee had been formed for examination. All the material sent is regarded as of such a comprehensive character and so abundant, that it may be used for the execution of all orders to be expected in Russia within the limits of the existing demand. The French company has deputed two engineers to serve with the Trust; of these one works in the "Project" Bureau, and the other in the lamp manufacturing workshops.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Argentina.—BUENOS AIRES.—April 23rd. Sanitary Works Department. Electrically-driven centrifugal pumps. Ref. 6,084/25/FL/EC2 (a).*

April 24th. Machinery and materials for the electric power station at Conception del Uruguay.

Australia.—MELBOURNE.—April 2nd. Victorian Railways. Metal- and carbon-filament lamps for electric train lighting.*

SIDNEY.—May 7th. N.S.W. Government Railways and Tramways. One 30-ton electric overhead travelling crane; one 15-ton ditto.

May 21st. Electric railway car equipment for 150 motor-cars and 150 trailer cars, consisting of motors, controllers, air compressors, pantographs, and accessories.*

March 27th. Postmaster-General's Department. Signal cable and insulated wire. (Schedule N.S.W. No. 69).*

BRISBANE.—April 9th. Brisbane Tramway Trust. Fifty 50-h.p., 500-V, d.c. traction motors; 30 ditto, 60 h.p., or, alternatively, 80 60-h.p., 550-V, d.c. traction motors, with 15 sets of control equipment and spare parts.

PERTH.—April 23rd. Postmaster-General's Department. Accumulators.*

Barrow-in-Furness.—March 17th. Electricity Department. One water-tube boiler, with two chain or travelling grate stokers; removal and re-erection of two Babcock & Wilcox boilers; e.h.p. steel cubicle switchgear; one automatic voltage regulator. (February 29th.)

Bedford.—April 1st. Electricity Department. One 3,750-kW single-phase turbo-alternator, with condensing plant. (March 7th.)

Belfast.—April 7th. Electricity Department. Three-phase e.h.p. a.c. switchgear; three-phase h.p. a.c. switchgear. (See this issue.)

Belgium.—March 26th. Belgian State Railway authorities (Office de l'Electricité), 25, Rue de la Charité, Brussels. Two lots of telephone cables. Particulars (Cahier des Charges Special No. 772) for 1 fr. 90 c.

Bexley.—Urban District Council. Electricity Department. Supply and installation of a 33,000-V, 3-ph. main transmission line consisting of 3,300 yd. of .15 three-core cable in duplicate. (February 29th.)

Bridlington.—March 20th. Electricity Department. Stores for 12 months, including lamps, lampholders, conduit switches, &c. (See this issue.)

Clacton-on-Sea.—The Urban District Council is inviting tenders for the foundations at the electric generating station for a new Diesel engine.

Dearne.—March 24th. Electricity supply: Electric cables; sub-station switchgear; electricity meters; three-phase transformers. (March 7th.)

Egypt.—CAIRO.—April 17th. Ministry of the Interior. Electric power station and distributing system.*

Halifax.—March 18th. Board of Guardians. Electrical fittings for six months ending September 30th, 1924. Mr. A. T. Longbottom, clerk to Guardians, Union Offices, Carlton Street, Halifax.

Kettering.—March 24th. Electricity Department. Two l.p. armoured lead-covered feeder cables. Two feeder pillars. (March 7th.)

London.—SOUTHWARK.—March 20th. Board of Guardians. Installation of electric lighting at the Newington Institution. (February 29th.)

METROPOLITAN WATER BOARD.—April 23rd. Two 25-kW steam-driven electric generators, switchboard, piping, &c., at Littleton pumping station; and one 150-kW steam-driven electric generator, switchboard, piping, &c., at Walton pumping station. (March 7th.)

BETHNAL GREEN.—March 18th. Board of Guardians. Motors and wiring installation at laundry, Waterloo House, Waterloo Road, Bethnal Green, E.2. Clerk to Board of Guardians, 79, Bishop's Road, E.2.

Manchester.—March 28th. Electricity Department. Six months' supply of electric cooking ranges, switches and fuses, and electric kettles. (See this issue.)

Marlborough.—Town Council. One 100-kW oil engine-driven d.c. generator, feeder, booster and switchboard; underground mains; house meters. (March 7th.)

Portsmouth.—March 19th. Board of Guardians. Electrical fittings for three months. Mr. H. C. Morrell, clerk, St. Mary's Road.

Rhondda.—March 31st. Electricity Department. A.c. house service meters, cables, joint boxes, &c., for 12 months. (March 7th.)

South Africa.—JOHANNESBURG.—March 24th. Municipal Council. Oil switches.*

Southampton.—March 26th. Electricity Department. One 1,000-kW rotary converter set with transformer and starting panel. (March 7th.)

Stockton-on-Tees.—March 24th. Electricity Department. Three core e.h.p. (11,000 V) cables, 4-core l.p. cables, and 4-wire l.p. overhead line. (See this issue.)

Trowbridge.—March 27th. Trowbridge and Melksham Union. Electric lighting installation at the Institution, Semington, Trowbridge. (February 29th.)

West Ham.—March 17th. Education Committee. Electrical wiring for 12 schools. (February 29th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Belgium.—International competition was again experienced on February 27th when the Belgian Post and Telegraph authorities in Brussels opened tenders for the supply and laying of telephone cables in (1) the Caroloregienne district and at Chatelineau; and (2) seven places in the Dinant district. Altogether five offers were received—two Belgian and one each from France, Czecho-Slovakia, and Germany. For the first contract the lowest bid was that of the French concern, La Société des Câbles, of Lyons, while for the second, a home firm, the Société des Ateliers de Constructions Electriques de Charleroi, submitted the lowest offer.

Sixteen concerns—fourteen Belgian and one each French and Dutch—last week submitted tenders to the Antwerp Provincial Government for the establishment of an electricity distribution system to serve the Beerse-Herenthals-Gheel-Moll-Arendonck-Turnhout districts. The lowest offer was that of the Société le Central Electrique du Nord, of Brussels.

Derby.—London, Midland & Scottish Railway (Midland Section).

Train-lighting lamps for the period ending June 30th, 1924.—General Electric Co., Ltd. (Accepted.)

Glasgow.—Tramway Committee. Recommended:—

Steel tires.—Steel Co. of Scotland, Ltd.
V.i.r. cable.—Siemens Bros. & Co., Ltd.
Lead-covered cable.—Western Electric Co., Ltd., and Hackbridge Cable Co., Ltd.
Iron and steel.—J. & C. Murray.
Relays.—James McMillan & Co.

Liverpool.—City Council. Accepted:—
25,000-kW turbo-alternator and Weir condenser and accessories for the Lister Drive power station (£108,460).—Metropolitan-Vickers Electrical Co., Ltd.

London.—Admiralty. Accepted:—
Supply of "Cosmos" carbon-filament lamps.—Metropolitan-Vickers Electrical Co., Ltd.

Fulham.—Borough Council. The undermentioned tenders were received for the supply of two 6,000-kW turbo-alternators and condenser. The matter is also referred to in our "Business Notes" to-day.

	Turbines & condensers complete.	Condensers only.	Delivery. 1st.	Delivery. 2nd.
W. H. Allen & Sons...	—	£8,628	22 wks.	26 wks.
Worthington-Simpson	—	10,203	July	August
Bellis & Morcom	£53,213	10,890	9 mths.	10½ mths.
Parsons & Co., Ltd.	58,522	10,200	26 wks.	34 wks.
English Electric Co.	55,754	10,036	7 mths.	8 mths.
Escher Wyss (Turbine only)	37,174	—	9 mths.	10 mths.
Richardsons, Westgarth	54,721	13,204	48 wks.	52 wks.
Hick, Hargreaves & Co.	—	10,176	7½ mths.	8½ mths.
Musgrave & Co.	—	11,930	—	—
Mirrlees, Watson & Co. Scheme A...	—	10,120	27 wks.	—
Scheme B	—	11,024		
Brush Electrical Co.	52,900	—	10 mths.	13 mths.
Cole, Marchent & Morley 2-9,400 sq. ft. Condensers ...	—	10,463	—	—
2-7,600 ,, ,, ...	—	8,903	—	—
James Howden & Co. With Eng. Elec. Co.'s Alt. ...	58,400	—	40 wks.	44 wks.
With Gen. Elec. Co.'s Alt. ...	59,854	14,200	36 wks.	44 wks.
With Parsons Alt.	58,442	—	46 wks.	48 wks.
Fraser & Chalmers Scheme A...	53,646	9,898	12 mths.	14½ mths.
Scheme B	55,586	8,594	14 mths.	17 mths.
Oerlikon, Ltd.	38,562	9,230	11 mths.	12½ mths.
Peter Brotherhood, Ltd.	47,294	11,370	8 mths.	9½ mths.
Daniel Adamson & Co. With E.C.C. Alt.	54,950	11,328	12 mths.	15 mths.
With G.E.C. Alt.	54,380	—	—	—
Metropolitan-Vickers	54,864	11,024	Oct. 1	Nov. 1
Brown, Boveri & Co. (Turbines only)...	28,244	—	—	—
British Thomson-Houston Co. ...	51,705	10,287	Oct. 1/24	Feb. 1/25
Vickers, Ltd....	—	10,190	—	—

For steam boilers, &c.:—

Contractor.		Delivery.
Clarke, Chapman & Co., Ltd. ...	£36,599	Eight months.
Vickers-Spearing Boilers, with C.I. economisers	£32,973	12 weeks 1st boiler. 15 weeks 2nd boiler.
With steel economisers	£31,668	18 weeks 3rd boiler.
Babcock & Wilcox	£34,200	8-9 months.
Stirling Boiler Co.	£31,800	End of Sept., 1924.
With Tridrum boilers	£30,100	
Clayton & Shuttleworth	£37,436	8-9 months.
John Thompson Boiler Co.	£37,781	1st boiler working 18 wks.

The Electricity Committee, in its report to the Council, states that the tender of Messrs. Oerlikon, Ltd., a Swiss firm, for the turbo-alternators is approximately £12,000 less than the lowest British offer. This being a very substantial difference, the expediency of placing the order abroad has naturally received the most careful consideration, and the question has been discussed in all its bearings. The Oerlikon Co. has since urged special reasons for the acceptance of its tender, but after the fullest consideration the Committee came to the conclusion that, having regard to the acute conditions of unemployment in this country, the Council would probably prefer to place the contract with British manufacturers, in addition to which, the difficulty and delay which would be incurred in repairing or replacing plant and machinery manufactured abroad, in the event of a breakdown, is of considerable importance. For these reasons the Committee has endorsed the unanimous recommendation of the Sub-Committee not to entertain the tenders of foreign firms.

Two firms, *viz.*, the English Electric Co., Ltd., and Messrs. Vickers, Ltd., also put forward, apart from their individual tenders, a proposal to undertake the whole of the responsibility for the complete scheme of extension as covered by the borough electrical engineer's total estimate, and the preliminary figures thus submitted by them were as follows:—

The English Electric Co., Ltd.	£150,700
Messrs. Vickers, Ltd.	£131,000

On examination of the tenders it was found that both firms had provided in their comprehensive schemes for more than was actually specified or required, and that some modification and revision of both schemes and total estimates was necessary. The engineer was accordingly instructed to go into these matters with the firms' representatives, and at the same time to ascertain if the British Thomson-Houston Co., Ltd. (who submitted a satisfactory tender for turbines and condensers), would also wish to quote for an inclusive scheme.

All three firms availed themselves of the opportunity afforded them, and submitted revised composite tenders and, after final and necessary adjustment, they worked out as follows:—

Messrs. Vickers, Ltd. (Accepted.)	**£123,815**
Power Securities Co. (B.T.-H.)	128,000
English Electric Co., Ltd.	130,720

The Committee recommends that the comprehensive tender of Messrs. Vickers, Ltd., of Vickers House, Broadway, Westminster, for the installation of all plant, including two 6,000-kW steam turbines and alternators, with accessories, two surface condensing plants and accessories, three 40,000-lb. boilers, with superheaters, economisers and stokers, switchgear, cables, boiler-house pipework, coal- and ash-handling plant, erection of buildings and foundations, &c., for the composite sum of £123,815 be accepted.

London County Council.—Highways Committee. Switchgear required in connection with the reconstruction of the Elephant and Castle sub-station:—

A. Reyrolle & Co., Ltd. (Accepted.)	**£6,156**
Bertram Thomas	6,215
Sprecher & Schuh Co.	6,285
Metropolitan-Vickers Electrical Co., Ltd.	7,018
Ditto (alternative)	6,169
Ditto (alternative)	6,398
General Electric Co., Ltd.	8,001
Switchgear & Cowans, Ltd.	8,168
Electric Construction Co., Ltd.	8,483
Ferguson, Pailin, Ltd.	8,534
Ditto (alternative)	8,449
Johnson & Phillips, Ltd.	9,002
British Thomson-Houston Co., Ltd.	9,396
New Switchgear Construction Co., Ltd.	10,114
Whipp & Bourne, Ltd.	17,983

Manchester.—Tramways Committee. Accepted:—
Copper tramway rail bonds.—T. Bolton & Sons, Ltd.; Forest City Electric Services Supply Co.
Steel girder tramway rails.—Cargo Fleet Iron Co., Ltd.
Special trackwork.—United States Steel Products Co., Ltd.

Electricity Committee. Accepted:—
Cable.—British Insulated & Helsby Cables, Ltd.; W. T. Glover & Co., Ltd.

Salford.—The Electricity Committee has recommended the acceptance of the offer of the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, to incorporate in the third turbo-alternator for the Agecroft power station certain improvements, which the company anticipates will result in an improved steam consumption, for which extra payment will be made, varying, as compared with the actual average steam consumption of the first two turbo-alternators to be installed by the company, from £3,500 for 2½ per cent. to £7,700 for 6 per cent., with an additional £1,200 for each complete 1 per cent. improvement above 6 per cent.

Tramways Committee. Accepted:—
Special trackwork for the junction of Blackfriars Street and Chapel Street (£1,257).—Hadfields, Ltd.

Electricity Committee. Accepted:—
1,223 yd. of e.h.p. cable (£904).—Enfield Cable Works, Ltd.
Two vertical-spindle centrifugal drainage pumps at Agecroft power station (£510).—Mather & Platt, Ltd.
One 20-cwt. lift for the boiler house (£539).—Etchells, Congdon & Muir, Ltd.

Forthcoming Events.

Radio Society of Great Britain (Transmitter and Relay Section).—Friday, March 14th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6.30 p.m. Discussion on "A Choke Control Transmitter Using Alternating Current for High-pressure Supply," to be opened by Captain Hartridge.

Royal Institution of Great Britain.—Saturday, March 15th. At Albemarle Street, W. At 3 p.m. Lecture, "Properties of Gases in Vacua," by Prof. Sir E. Rutherford.

Institution of Engineers-in-Charge.—Saturday, March 15th. At the Holborn Restaurant, London. At 6 p.m. Annual dinner.

Electrical Power Engineers' Association (London Western Section).—Saturday, March 15th. At Pritchard's Restaurant, London. At 6.30 p.m. Annual dinner.

Institution of Welding Engineers.—Monday, March 17th. At the Liverpool Municipal Technical School. At 7.30 p.m. Lecture on "Steel and its Properties and their Relation to Welding," by Prof. F. C. Thompson.

Paisley Association of Engineers.—Tuesday, March 18th. At 29, High Street, Paisley. At 7.30 p.m. Apprentice papers.

Institution of Electrical Engineers.—Thursday, March 20th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6 p.m. Lecture on "The Nature and Reproduction of Speech Sounds (Vowels)," by Sir Richard Paget, Bart.

Informal Meeting.—Monday, March 17th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "Illuminating Engineering: Its Application and Value to the Electrical Industry," to be opened by Messrs. L. Gaster and J. S. Dow.

(North-Midland Centre).—Tuesday, March 18th. At the Hotel Metropole, King Street, Leeds. At 7 p.m. Lecture, "Some Researches on the Safe Use of Electricity in Coal Mines," by Prof. W. M. Thornton.

(North-Western Centre).—Tuesday, March 18th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "The Future of Main-line Electrification on British Railways," by Lieut.-Col. H. E. O'Brien.

(Mersey and North Wales (Liverpool) Centre).—Monday, March 17th. At the University, Liverpool. At 7 p.m. Paper on "The Future of Main-line Electrification in Great Britain," by Lt.-Col. H. E. O'Brien.

(Western Centre).—Monday, March 17th. At the South Wales Institute of Engineers, Park Place, Cardiff. At 6.30 p.m. Address by the President, Dr. Alex. Russell, F.R.S.

(Sheffield and District Territorial Sub-Centre).—Wednesday, March 19th. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Paper on "The Design of Apparatus for the Protection of Alternating-current Circuits," by Mr. A. S. FitzGerald.

Physical Society of London.—Jubilee Celebrations.—Thursday, March 20th, to Saturday, March 22nd. At the Institution of Electrical Engineers, Victoria Embankment. Opening, Thursday, March 20th, At 2.30 p.m.

Illuminating Engineering Society.—Friday, March 21st. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussions on "The Use of Light for Outdoor Advertisements," to be opened by Mr. G. P. Garbett; and on "The Use of Light in Shops, in Show-windows, and for Display Purposes," by Miss M. Partridge.

Manchester Electro-Harmonic Society.—Friday, March 21st. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. Concert.

Edinburgh Electrical Society.—Friday, March 21st. At 4, Queen Street. At 8 p.m. Special wireless night.

Birmingham and District Electric Club.—Friday, March 21st. At the Grand Hotel, Colmore Row, Birmingham. At 7 p.m. Lecture on "Traction Electric Motors."

British Electrical Development Association.—Friday, March 21st. At the Hotel Cecil. At 12 noon, annual general meeting; 1 p.m., annual luncheon.

Salesmanship Conference.—Friday, March 21st. At the London School of Economics, Houghton Street, Aldwych, W.C.2. At 7.30 p.m. Paper on "Electricity the Real Domestic Help," by Mr. E. E. Hoadley.

Junior Institution of Engineers.—Friday, March 21st. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Sulphuric-Acid Plants, New and Old, Constructional Details and Working," by Mr. P. Parrish.

The "Electrical Review" Service Department.

Inquiries must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of makers or suppliers of:—

Swift-sure adapters.
Belmos small motors (for ship work).
Cabot quilt for sound-proofing.
Wood Separators (wet treated) for accumulators.

Notes.

The Batti-Wallahs' Society.—At the general meeting held on Wednesday, March 5th, the election of officers for 1924 resulted as follows:—President, Mr. A. J. Greenly; Vice-President, Mr. F. Pooley; Committee, Messrs. A. W. Blake, M. R. Gardner, H. S. May, G. S. Peckham, C. Newton Russell, J. H. Sandiford; Hon. Secretary, Mr. Mark Whitgift, 7, Coulter Road, Hammersmith, W.6; Assistant Hon. Secretary, Mr. W. W. Browne, 12, Norfolk Street, W.C.2.

The annual dinner will be held at the Hotel Cecil on Wednesday, March 19th.

Social Events.—ELECTRICAL POWER ENGINEERS' DINNER.—The fifth annual dinner of the North-Eastern Division of the Electrical Power Engineers' Association was held at Newcastle-on-Tyne on March 1st. The chairman (Mr. A. W. Crompton, A.M.I.E.E.) presided, and it was intimated that the president of the Association (Mr. T. A. G. Margary, A.M.I.E.E.) was unable to be present owing to influenza. Proposing the toast of the "Association," Mr. R. P. Sloan, C.B.E., M.I.E.E., said it had undoubtedly done great service for the electrical power industry generally. It had removed discontent, had tended to encourage loyalty of staff, and had improved the class of recruit. He thought it would be well if there were more frank discussion between the Association's National Executive and the employers. There had been two instances, one comparatively recently, where, largely owing to the want of frank discussion, considerable flutter in the dovecotes had occurred. The Chairman, responding, said that, unfortunately, there had been misunderstandings, and he suggested that some of the trouble had arisen through lack of faith in the Association. However, he thought he was correct in saying that the difficulties had been removed. Mr. W. Arthur Jones, general secretary, who also responded, said that the president desired him to say that before his year of office was over it was his intention to visit the North-Eastern Division to compensate for his absence that evening. It would be agreed that some definite scheme of training was essential to every company where pupils or apprentices were employed. It was to be hoped that employers would be able to introduce a scheme so as to obtain a similar measure of control over pupils and apprentices. "The Electrical Industry" was proposed by Mr. P. Wood, and Mr. T. Carter, M.I.E.E., replied. Mr. D. E. Greenwood, A.M.I.Mech.E., toasted the guests, and Mr. H. S. Tennant, M.Sc., M.I.E.E., responded.

International Conference on Extra-High-Pressure Transmission.—We understand that numerous applications for the English version of the proceedings at the recent international conference are being received; some of them are addressed to this office, and for the convenience of readers we may again state that communications should be sent to the General Secretary, Union des Syndicats de l'Electricité, 25, Boulevard Malesherbes, Paris.

Register of Battery-Charging Stations.—In order that it shall continue to be of utility to users of electric motor vehicles the Electric Vehicle Committee has decided to revise its register of charging stations.

Late Legal.—BRITISH THOMSON-HOUSTON CO., LTD., v. COMMERCIAL ELECTRIC CO., LTD., and CROWTHER & OSBORN, LTD.—Mr. Justice Tomlin, on Tuesday last, said that he had consulted his brother judges with regard to these cases (*vide* our "Legal" columns), and had come to the conclusion that no postponement could be made unless the parties came to an agreement. Sir Duncan Kerly, for defendants, said that no agreement was possible—the defendants would be left in the plaintiffs' hands. His Lordship, while not agreeing with this view, gave defendants leave to appeal from his decision not to stay the actions. It was arranged between counsel that none of the cases under the 1909 patent should come on for hearing before next Monday week.

Appointments Vacant.—Sales engineer for the Yorkshire Electric Power Co. Shift engineer for the Hoylake and West Kirby Urban District Council Electricity Station. Sales Engineer for the Sevenoaks and District Electricity Co., Ltd. (See our advertisement pages to-day.)

Edinburgh and Lothians Electricity District.—In the City Chambers, Edinburgh, on March 10th, the Electricity Commissioners held a second inquiry regarding the draft clauses with reference to the delimitation of the above-named area. The first and main inquiry, it will be remembered, was held in December, 1922, and the Commissioners' visit on Monday was merely in connection with the adjustment and confirmation of clauses in the Order.

Represented at the inquiry on Monday were the Corporation of Edinburgh, the counties of East Lothian and Midlothian, the burghs of Musselburgh and North Berwick, Leith Dock Commission, and the Electrical Contractors' Association.

An area has been delimited which will be supplied from the new station at Westbank, Portobello, of the Edinburgh Corporation, which, according to the arrangement, will undertake the distribution within the city, and will supply electricity in bulk to the Lothians Electricity Co., which has undertaken the distribution within East Lothian and Midlothian. An agreement between the Corporation and the company had been prepared, and several points remained for adjustment by the Commission. They were discussed with the object of safeguarding the interests of the parties. It was stated that a decision on the points raised would be intimated shortly. As soon as the agreement is completed the Commissioners will proceed to make an Order and submit it to the Minister of Transport for confirmation.

The Commissioners present at the inquiry were Mr. H. Booth, who presided, and Mr. W. W. Lackie. They were accompanied by Mr. E. W. Hudson, solicitor, and Mr. D. S. Camberlege (clerk).

Institution Notes.

Institution of Electrical Engineers.—INFORMAL MEETING.—At the meeting of the Informal Section, on March 3rd, Mr. E. F. Hetherington was in the chair when Mr. R. D. Spurr opened a discussion on d.c. networks, which he showed were not as bad as they are reported to be, nor was the a.c. system substituted as efficient as it was sometimes claimed to be. He showed the "appalling" cost involved in changing over, and then spoke of his methods of grappling with this problem. Mr. Spurr warmly advocated the use of rotary converters of 500 kW minimum capacity as being the best solution. In the subsequent discussion, which showed the meeting to be mainly in disagreement with the opener's remarks, the mercury rectifier was discussed at considerable length, and the general opinion seemed to be that it was a most valuable contribution to the solution of the difficulties described. Mr. Spurr's opinion was that it was not yet at its best development. Messrs. H. Craske, R. Grierson, A. F. Harmer, E. F. Hetherington, A. G. Hilling, R. V. Hook, C. M. Mayson, and A. H. E. Tomkinson spoke, and Mr. Spurr, in concluding the debate, agreed that if he were starting afresh he would adopt a three-phase four-wire system of distribution.

MAGNETIC DEMONSTRATION.—The ordinary meeting on March 6th was preceded by an exhibition in the Common Room by Mr. W. B. Savers of apparatus designed to demonstrate "magnetic induction, attraction, and repulsion, especially among free and moving bodies."

MERSEY AND NORTH WALES (LIVERPOOL) CENTRE.—On Friday last the first annual dinner of the Mersey and North Wales (Liverpool) Centre of the Institution was held at the University Club, Liverpool. The chairman, Mr. E. M. Hollingsworth, presided, and there were present some 80 members and guests. After the toast of "The Duke of Lancaster," Mr. J. S. Highfield proposed "The City of Liverpool," referring first to his five years' strenuous work at St. Helens, with the chairman as his assistant. The city, one of our "gates of Empire," might well be proud of its great buildings, its river, and its miles of docks. The Lord Mayor (Mr. Arnold Rushton), responding, said that the Institution of which that was a new Centre, was synonymous with progress. Liverpool progressed by seizing all opportunities, and always employed the best men obtainable to carry on its work.

Mr. J. E. James proposed "The Institution of Electrical Engineers," suggesting that the marvellous achievements of electricity in the past were nothing to what the future would bring forth. Responding, Dr. Alex. Russell (president, I.E.E.) said that with a membership of 11,500, the Institution was easily the largest engineering institution in the country, and at the present rate of development, in three years it would be the largest professional body. The Mersey and North Wales (Liverpool) Centre, which had 500 members, was one of its most influential branches, and they were proud of it. Sir Oliver Lodge, formerly professor of physics at Liverpool University, had hardly received due credit for his pioneer work in wireless telegraphy; in Prof. Marchant he had a worthy successor. This year the Institution would entertain 500 visitors to the World Power Congress, and would celebrate the centenary of Lord Kelvin in July; a permanent memorial to their greatest past-president might well take the form of a research laboratory at the N.P.L.

Mr. G. A. Juhlin (chairman, North-Western Centre I.E.E.) proposed the health of the chairman, expressing the pleasure that his Centre had felt in helping its Liverpool friends, and paying a tribute to the personal qualities of Mr. Hollingsworth, who, in responding, acknowledged the debt that the Centre owed to its elder brother, and referred to the educational work that the new Centre was doing.

Mr. G. H. Nisbett proposed "Our Guests," adding some entertaining reminiscences of his early experiences with the City of London E.L. Co., and Mr. F. C. Wilson (chairman of Liverpool Tramways and Electricity Committee), in the course of his reply, said they looked to the electrical engineer for help in meeting foreign competition by developing the supply of electricity.

Lastly, Prof. E. W. Marchant (vice-president, I.E.E.) proposed "The Press," which, he said, thanks to the work of the electrical engineer, had greatly improved during the past 50 years, and Mr. A. H. Allen responded.

A musical programme was performed during the evening, and in every way the function was very successful and enjoyable.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. William Forbes, general manager, Aberdeen Corporation Tramways, has been granted an increase of £150 per annum, making his yearly salary £800.

A Sydney newspaper reports that Mr. J. M. Crawford has been appointed chief electrical engineer in the Postmaster-General's Department, at a salary of £1,050. Mr. Crawford, who is 52 years of age, went out from England several years ago to fill the position of assistant-chief electrical engineer. For the past four or five years he has been State engineer in New South Wales. It is understood that his successor will be Mr. Robert Lawson, Victorian State engineer.

Mr. W. C. Mountain has taken his son-in-law, Mr. W. Wellesley Wood, into partnership, and the firm will in future be carried on in the name of W. C. Mountain, Son & Wood, consulting electrical and mechanical engineers, Sun Buildings, Newcastle-on-Tyne. For twelve years Mr. Wood was associated with the late firm, Ernest Scott & Mountain, Ltd., and for the following twelve years he was with the General Electric Co., Ltd., at Witton. He will reside in Birmingham.

The *Industrial Australian and Mining Standard* states that the following have been appointed as the delegation to represent Australia at the World Power Conference: Senator J. D. Millen, president-elect of the Institution of Engineers, Australia; Mr. H. W. Gepp, general manager, Electrolytic Zinc Co. of Australasia, Ltd.; Mr. H. W. Myers, chief assistant electrical engineer, New South Wales Government railways and tramways; Mr. Russell Sinclair, O.B.E., member of the council of the Institution of Engineers, Australia; and Mr. L. L. Murray, electrical engineer, of London, the son of a former Victorian Railways Commissioner, who has been practising in London for a number of years as an electrical engineer.

The Lord President of the Council has appointed Mr. F. S. Sinnatt, M.B.E. (Mil.), M.Sc. (Tech.), F.I.C., M.I.Min.E., to be Assistant Director of Fuel Research, as from April 1st. Mr. Sinnatt is lecturer in fuels in the University of Manchester, Faculty of Technology. He is also director of research to the Lancashire and Cheshire Coal Research Association, and has been in charge of the physical and chemical survey of coal seams which the Association is carrying out for the Fuel Research Board in the Lancashire and Cheshire coalfields.

The resignation of Mr. Frank A. Newington, engineer and manager of Edinburgh Corporation Electricity Department, for reasons of health, was submitted to the Town Council meeting on Thursday last week. The Electricity Committee recommended that the resignation be accepted, and that a retiring allowance of £750 per annum be granted. Mr. Newington has been engineer of the city's electricity department for 28 years, having succeeded the late Mr. E. W. Monkhouse, who was the first occupant of the post, as resident engineer. Under Mr. Newington the undertaking has greatly developed, the crowning work of his career being in connection with the great power station at Portobello, in which he co-operated with Sir Alexander Kennedy, the consulting engineer.

The Edinburgh Corporation has approved the following salary increases:—Mr. J. Lingard, superintendent at Portobello power station, from £627 to £647; Mr. J. C. Robertson, assistant superintendent, from £535 to £555; Mr. G. Ogg, mains superintendent, from £565 to £595.

At the annual dinner of the employés at the Kingston-on-Thames Corporation Electricity Works on March 1st, over which the Borough Electrical Engineer, Mr. E. T. Kingham, presided, the chief guest was Councillor F. W. Cheyney, chairman of the Lighting Committee, who was presented with a silver salver as a token of esteem.

In our reference to Mr. Roger T. Smith's retirement in our last issue, "to the Great Western Railway" should have followed the words "electrical engineer." As rendered, our notice might give the impression that Mr. Smith was connected with the London, Midland and Scottish Railway.

After considerable discussion and the rejection of a number of amendments, the Eastbourne Town Council has approved a recommendation of the Electricity Committee that the salary of Mr. J. K. Brydges, the borough electrical engineer, be advanced by £100 per annum, making £900 per annum. It was mentioned that Mr. Brydges had saved the Council £2,000 in consulting engineers' fees by supervising the installation of new plant, and that in twelve other towns similar in size to Eastbourne the salary of the electrical engineer was higher.

The Bradford Corporation Electricity Committee has placed on record, through its minutes, an expression of appreciation of the valuable services of the city electrical engineer (Mr. Thos. E. Roles) and members of his staff, together with certain other municipal officials, in connection, during many months, with the work of the Local Authorities' Conference in the matter of the scheme for the future generation and main transmission of electricity in the West Riding (Aire and Calder) Electricity District, and in preparing and sustaining the Conference submissions at the Commissioners' inquiries at Leeds in 1921, and at Bradford in 1924. The resolution was expanded to express also recognition of the "able and extremely urbane and tactful services of Alderman Wilfred Turner, the Conference chairman (and chairman of the Bradford Electricity Committee) in guarding the interests of the local authorities, including Bradford, who constitute the Conference of Local Authorities, in the proceedings of the Conference and at the inquiries."

Woolwich Town Council has increased the salary of the Borough Electrical Engineer, Mr. G. W. Keats, from £800 to £900 per annum.

Mr. W. E. W. Millington, M.Inst.C.E., &c., has relinquished his position as general manager to Messrs. Holden and Brooke, Ltd., of West Gorton, Manchester, and has set up as a consulting engineer at 54, Imperial Buildings, Oxford Road, Manchester.

Mr. Arthur J. Cridge, M.I.E.E., has relinquished his position as sales engineer to the Brush Electrical Engineering Co., Ltd., in order to take up the appointment of assistant sales manager to Messrs. Johnson & Phillips, Ltd. His headquarters are at the Works, Charlton, S.E.7, and he entered upon his duties there on March 3rd.

Obituary.—Mr. W. J. Francis.—A *Reuter* dispatch reports the death of Mr. Walter Joseph Francis, president of the Engineering Institute of Canada, at the age of 52 years.

New Companies Registered.

Speedometer Supply Co., Ltd. (196,152).—Private company. Registered March 4th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of speedometers, mileage recorders, clocks, motor cars and accessories, wireless products, &c. The first directors are:—Mary Goulding, Morley House, Amhurst Road, E.8, secretary; L. Toole, Holbein House, Sloane Square, S.W., accountant. Qualification, one share.

Wireless Waves Co., Ltd. (196,058).—Private company. Registered February 28th. Capital, £1,000 in £1 shares. To carry on the business of mechanical engineers, contractors for manufacturers, licensors and licensees of and dealers in machinery, wireless apparatus, &c. The subscribers (each with one share) are:—T. W. Franklin, 6, North Edwards Street, Cardiff, electrical engineer; Phyllis Thomas, 67, Monthermer Road, Cardiff, clerk. T. W. Franklin signs as managing director. Qualification, one share. Remuneration as fixed by the company. Registered office: 11, Charles Street, Cardiff.

Scientific Glass Co., Ltd. (196,081).—Private company. Registered February 29th. Capital, £2,000 in £1 shares. To carry on the business indicated by the title and that of agents for makers, manufacturers, factors and vendors of and dealers in all kinds of wireless and electrical apparatus, &c. The subscribers (each with one share) are:—W. H. Gwynn, 28, Kirkley Road, Merton, S.W.19, scientific glass blower; C. F. H. Hull, 35, Nottingham Place, W.1, incorporated accountant. W. H. Gwynn is managing director for 10 years, with not less than £412 per annum as remuneration. Solicitor: E. G. H. Olley, 11, Queen Victoria Street, E.C.4.

Bonnella Brothers, Ltd. (196,092).—Private company. Registered March 1st. Capital, £7,000 in £1 shares (1,000 10 per cent. preference and 6,000 ordinary). To carry on the business of electrical engineers, manufacturing electricians, manufacturers of, agents for, and dealers in all kinds of general electrical supplies, motor cars, parts, accessories and all materials, apparatus and requisites for kinematograph theatres, &c. The subscribers (each with one ordinary share) are:—S. J. Sulston, 32, Deal Road, S.W.17, solicitor's clerk; R. Kerdwell, 51, Stembridge Road, Anerley, S.E.20, solicitor's clerk. The first directors are:—A. Bonnella and G. J. Bonnella, addresses not stated. Solicitors: Churchill, Clapham & Co., 1, Broad Street Place, E.C. Registered office: 11, Bucknall Street, Bloomsbury W.C.

Malleable Fittings (London), Ltd. (196,045).—Private company. Registered February 28th. Capital £2,000 in £1 shares. To take over the business of manufacturers of electrical conduit and other fittings carried on by Malleable Fittings, Ltd., at 208-210, Stewarts Road, Wandsworth, S.W., and to adopt an agreement with the said company, —. F. Cooper, Miriam Ravenhill, and E. D. Jennings. The permanent directors are:—J. T. Forrester, 29, St. Luke's Road, Clapham, S.W.4, West African merchant; E. D. Jennings, 67, Dartmouth Park Hill, N.W.5, importer and exporter. Qualification, £100. Registered office: 210, Stewarts Road, Wandsworth, S.W.8.

Official Returns of Electrical Companies.

Albert Lee & Co. (1923), Ltd.—Debenture dated February 22nd, 1924, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. M. J. Colville-Hyde, 3a, Buckingham Gate, W.

Hindhead and District Electric Light Co., Ltd.—Issue on February 14th, 1924, of £150 debentures, part of a series already registered.

Adelaide Electric Supply Co., Ltd.—Acknowledgment of indebtedness dated February 25th, 1924 (supplemental to trust deed dated June 11th, 1918, and deeds supplemental thereto), to secure £350,000 (redeemable consolidated debenture stock). Property charged: The company's undertaking in Australia (excluding dividend equalisation fund and uncalled capital). Holders: Electric and General Investment Co., Ltd., Winchester House, Old Broad Street, E.C. (Stock sold at 96 per cent. to Electric and General Investment Co., Ltd.)

British Columbia Electric Railway Co., Ltd.—Trust deed dated February 19th, 1924, to secure £770,000 5 per cent. (income tax free) debenture stock, and constituting a fixed charge on £1,100,000 4½ per cent. perpetual consolidated debenture stock of the company. Holders: The British Empire Trust Co., Ltd., Stafford House, King William Street, E.C. (The stock is issued at the price of £95 per £100 (or $450). The British Empire Trust Co., Ltd., guarantees the subscription of the whole amount of the stock for a commission of ¼ of 1 per cent. on the whole amount plus an additional 1 per cent. on any stock it might actually be called upon to take up.

Crystal Engineering Co., Ltd.—First debenture dated February 8th, 1924, to secure £250, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Bower Electric, Ltd., 15, Grape Street, Shaftesbury Avenue, W.

Cox-Cavendish Electrical Co., Ltd.—R. J. Blackadder, of Norfolk House, 28, Norfolk Street, Strand, W.C.2, C.A., was appointed receiver on February 20th, 1924, under powers contained in trust deed dated October 25th, 1920.

City Notes.

Underground Electric Railways Co. of London, Ltd.

The annual meeting of the company was held on March 6th under the chairmanship of Lord Ashfield. The company's report was reviewed in our last issue (p. 388). In the course of his speech, Lord Ashfield dealt with the present state of traffic in London. He said that he hoped that the Bill dealing with the matter, which the Prime Minister had promised should receive consideration during the present session of Parliament, would contain effective measures to cope with the problem. Referring to the growing competition of motor omnibuses, the chairman said that if railways and tramways constructed under statutory authority were to be submitted to this, a policy of expansion was impossible, and the maintenance of existing services doubtful. If London was to secure what he for one thought it must have, a continually improving and expanding underground railway system, some form of public control over omnibus routes and services must be secured. During the year the public had enjoyed the benefit of lower fares, while the return on the capital of the companies as a whole was slightly less at 4.3 per cent. Although no dividend had yet been paid upon the ordinary capital of the company, it was significant that all transport undertakings in Greater London constantly tended to be remunerative. The return on the capital of the underground railways ranged in pre-war days from 1.9 to 2.5 per cent. Since the war it had ranged from 3.2 to 3.7 per cent. Neither municipal nor company undertakings had secured an adequate return upon their capital expenditure, and yet he was certain that if the various transport facilities of London worked harmoniously together they could earn sufficient for their mutual support without any increase of present fares. Although the tramways in which the company was interested had given an increased service of 700,000 car-miles, they had failed by three millions to reach the total of passengers carried in 1922, due to the growing omnibus competition.

The company had been formed to assist the several operating companies in the finding of the capital required for the construction and improvement of their works, and at first the object was fulfilled generously. In recent years, however, out of £15,000,000 of capital raised by the operating companies, the Underground Co. had only contributed £600,000. The balance was raised by the issue of prior-charge stocks; this process could not be continued. There was a pressing need for the reconstruction of the capital of the company on a more elastic basis. The 6 per cent. income bonds took profits that the ordinary shares might have had, owing to the advantage conferred on them by the exchange rates. It was not a paying proposition to pay these off at the present rates of exchange. Another obstacle was the existence of the 1s. "A" shares. These were of small nominal value, but carried considerable income rights. There were three questions to be faced: First, how to increase the capital so as to provide cash for the purchase of further securities in the operating companies. Secondly, how to reduce the capital charges in respect of the fixed-interest stocks and bonds already issued, and, thirdly, how to convert into some more satisfactory form of share the 1s. "A" shares. To his (Lord Ashfield's) mind there was at least one condition which, until it was satisfied, precluded all answers. Until the dollar value of the pound sterling reached parity any reconstruction of capital was likely to be expensive and, therefore, prohibitive. Although the directors would continue to search for a solution, it was not likely that one could be found to fully meet the circumstances; some minor adjustments might be found possible, but that was all.

In conclusion, Lord Ashfield made reference to the threat of labour troubles in connection with London's transport systems. He said that he hoped the friendly relations between the company and the staff would be continued, and that co-operation and amicable discussion would aid in solving all difficulties.

Sir Robert Perks described as excessive the amounts placed to reserve by the companies of the group, but Lord Ashfield pointed out that the funds were in some cases inadequate, or only just sufficient, to meet the need for the replacement of stock, &c.

The report and accounts were adopted.

Kensington and Knightsbridge Electric Lighting Co., Ltd.

Col. R. E. B. Crompton presided at the annual meeting on March 6th, and in presenting the report and accounts (*vide* ELEC. REV., February 29th, p. 346), said that the working costs per kWh sold had fallen from 1.54d. to 1.43d., and management costs had fallen by 11 per cent. The large contributions in respect of depreciation and contingencies were made in pursuance of the directors' policy of having a large amount of liquid resources to meet the cost of modernising the plant. The reduction in costs had made it possible to reduce charges to consumers. The distributing system was being thoroughly modernised, and at the three principal distributing stations a great deal of work had been carried out. At Kensington Court several motor-generators had been sold and replaced by motor-converters of the latest type, and high-pressure switchgear had been installed. The whole of the old steam plant at Cheval Place had been removed, and two large accumulator batteries had been installed. About two-thirds of the motor-transformer plant at Albert Vaults had been brought up to date. The gross expenditure had been £32,252, but the writing-off of the cost of old plant amounted to £30,566, making the net expenditure £1,685. The linking up of the company's mains with those of the Central Electric Supply Co. would add to the security and continuity of the supply. A suitable site for a new transformer station had been secured, and designs for its construction were in course of preparation. The report was adopted, and at an extraordinary meeting which followed the terms of the new London Electricity Supply Bill were approved.

Waste Heat and Gas Electrical Generating Stations, Ltd.

The net profits of the company for 1923, after deducting administration expenses, amounted to £24,776, an increase of £4,580. To this was added £14,018 brought forward, making £38,794. A dividend of 8 per cent. for the year is recommended, which will absorb £25,600 (1½ per cent., £4,800, already paid), leaving £13,194 to be carried forward. Arrangements were completed during the year for extending the company's power station at Horden Colliery for the purpose of utilising the waste heat and gas from a new battery of coke ovens. The installation of two new boilers and an additional turbo-generator is now being carried out, and should be completed during the next three months. The capital expenditure incurred during the year in connection with these extensions amounted to £6,084. The sale of spare plant partly offset this, making the net expenditure £4,672. The meeting was held yesterday (Thursday).

Charing Cross Electricity Supply Co., Ltd.

Mr. W. F. Fladgate, M.V.O., presided at the annual meeting on March 4th, and in moving the adoption of the report and accounts (*vide* ELEC. REV., March 7th, p. 388) said that owing to reductions in charges, both the West End and City undertakings had received less revenue, although working expenses were reduced at the same time. The re-modeling of the Bow station was approaching completion. In addition to the three sets, with an aggregate capacity of 24,000 kW, to which he had referred at the last meeting, a fourth machine of 15,000-kW capacity was being installed, together with two new boilers; this would complete the present extensions, although it would probably be necessary to provide additional plant next year. If, however, the new Bill became law, this expenditure would fall upon the combined companies. The chairman then reviewed the provisions of the Bill, and in referring to the sliding scale, the institution of which is one of the conditions of extended tenure, said that he would not admit that the electricity supply of London was either deficient or unreasonably dear. However, he thought that the proposals of the London County Council, combined with the effect of the technical scheme, would bring about great improvements, and would place London as high as any city in the world in its power to develop a cheap and abundant supply of electricity.

The report was adopted, and a resolution authorising the capitalisation of £96,000 of the general reserve was approved.

At a subsequent meeting approval was given to the terms of the new Bill.

Metropolitan Electric Supply Co., Ltd.

The annual meeting of this company, whose report was reviewed in our issue of February 29th (p. 346), was held on March 4th. In presenting the report, the Chairman (Mr. A. W. Tait, C.B.E) said that the company had taken over the whole load of the Uxbridge Company, which last year amounted to 12,379,000 kWh. The two stations at Willesden and Uxbridge were now linked up and, apart from the greater economy, this provided a safeguard in case of breakdown. During the year, bulk-supply agreements had been entered into with the Colne Valley Co., the Twickenham and Teddington Electric Supply Co., and the Egham and Staines Electricity Co. The mains had been laid for the first two supplies, and the remainder were in hand. During the early part of the current year an agreement had been made with the Slough and Datchet Co., and negotiations with other distributors in the area were pending. The company had acquired a controlling interest in the Chesham Electric Light and Power Co., and this undertaking was being linked up with the company's mains. During the year the new plant at Willesden had been put into operation, but the increasing demand necessitated further plant, and a 12,000-kW set would shortly be installed. It was also proposed to obtain a bulk supply from the Central Co. to meet the demand. Although the estimated loss of revenue due to reduced charges was £40,000, the revenue had shown an increase by reason of the larger output; further reductions were being made immediately. The increase in generating costs was very small when due regard was had to the increased sales of energy. The report was adopted.

Newcastle and District Electric Lighting Co., Ltd.

The net profit for 1923, after charging debenture and loan interest, writing off the balance of debenture-issue expenses, and allowing £18,000 for depreciation, was £14,270, which, together with £14,034 brought forward, made a total of £28,304. A dividend of 6 per cent., less tax, is recommended. This will absorb £13,722, leaving a balance of £14,582 to be carried forward. A further amount of £6,000 of the company's second mortgage debentures were redeemed, and loans amounting to £4,237 were repaid during the year.

After to-day's annual meeting an extra-ordinary meeting is to be held to consider the splitting of the £10 shares into ten shares of £1 denomination.

London and Suburban Traction Co., Ltd.

Addressing the shareholders at the annual meeting of the company, on March 5th, Lord Ashfield (chairman) said that during the past year the company had experienced a regrettable setback, due to the influx of 'buses upon the tramway routes. So long as the tramways were operated in harmony with the London General Omnibus Company, the 'buses had merely supplemented the tram services, but the advent of rival omnibuses had forced the L.G.O.C. to increase its services, to the detriment of the tramways. All the operating companies had paid reduced dividends, the total income from them being £19,000—£57,000 less than in 1922. Referring to the costs of repairs and maintenance, the chairman again complained that the tramways were forced to keep in good condition routes which were used by heavy motor vehicles. Tramways, he said, were in a difficult position. Since the war the more flexible motor omnibus had grown in size, and the advantages derived from a special tramway track were tending to disappear. The field for tramway development was clearly limited, although he would not say that tramways were obsolete or should be abandoned, and the railless trolley vehicle would not widen it. The income from the omnibuses owned by the Tramways (M.E.T.) Omnibus Co., Ltd., had increased by £5,000 to £50,000. The results of working of the North Metropolitan Electric Power Supply Co. were satisfactory, but insufficient to affect beneficially the general result.

Aron Electricity Meter, Ltd.

Col. R. E. B. Crompton, C.B., presided at the annual meeting, on March 7th, and in his speech referred to the death of Mr. W. J. Fisher, one of the directors, since the report was issued. He briefly reviewed the history of the company, and then called upon Mr. H. Kahn, the managing director, to deal with the report and accounts, which were abstracted in our issue of February 29th (p. 346). Mr. Kahn said that the profit made at the company's small factory at Salusbury Road had enabled the company to keep its head above water during the critical years since 1914. The French company, which had been liquidated, had never made any profits worth mentioning. The loss on the Austrian company was principally due to the loss on exchange on its sterling debt to the London company. The loan from the Swiss Bankverein had been paid off out of the first money received on account of the claim against Germany. The issued share capital had been reduced by the putting back of purchased preference and ordinary shares held by ex-enemies into unissued capital. The outstanding debentures, with the exception of about £1,700, had been redeemed or purchased by the company. The company had lost its German factories, but had about £110,000 in cash or its equivalent. It was proposed to make the best of the Vienna factory, enlarging its scope where necessary. The London premises and machinery would be added to if that was justified by additional business. There were enormous potentialities in their association with the General Electric Co., Ltd.

In a discussion which followed Mr. Kahn's speech, Mr. Hugo Hirst urged the board not to be too hasty in its use of the £110,000 referred to. It was better to wait for the right thing than to do something merely in order to have it done. The report and accounts were adopted.

County of London Electric Supply Co., Ltd.

The capital expenditure during 1923 showed a net increase of £120,555, making the total £3,072,167. The expenditure on the "Barking" supply amounted at December 31st last to £720,567.

The revenue for the year, after deducting generation and distribution costs, repairs, and a proportion of rents, rates, taxes, directors' fees, general establishment, and other charges, and wages and salaries, was £678,558, to which was added £42,727 brought forward, making £721,285. From this the following amounts have been deducted:—Interest on debenture stock and temporary loans, less tax, £63,880; sinking fund for 7 per cent. debenture stock, £5,000; investment reserve, £72,591; taxation reserve, £10,000; contingencies reserve, £15,000; reserve for depreciation, renewals, &c., £50,000; and general reserve, £250,000, leaving £254,814. To this is added interest on capital chargeable to "Barking" supply, £48,125, making £302,939 available for distribution. Interim dividends absorbed £54,014, and it is proposed to deal with the balance of £248,924 as follows:—Final dividend on 725,000 six per cent. fully-paid preference shares, £16,720; final dividend at 3 per cent. on 500,000 fully-paid preference shares (July, 1922, issue) from the due dates of instalments to December 31st, 1923, £10,810; final dividend at 8 per cent., less tax, on 830,000 fully-paid ordinary shares (making 12 per cent. for the year), together with a bonus of 3 per cent., less tax, £70,187; final dividend, making 12 per cent. for the year, together with a bonus of 3 per cent., less tax, on 500,000 fully-paid ordinary shares (July, 1922, issue) from the due dates of instalments to December 31st, 1923, £32,912; leaving £118,295 to be carried forward. The applications during the year represented 14,624 kW, making the total connected load at December 31st, 119,241 kW. The number of kWh sold rose from 58,241,758 to 65,678,671. The total number of consumers supplied is now 54,000. The construction and equipment of the new station at Barking are proceeding satisfactorily, and the laying of the inter-connecting mains through to the company's London areas is in hand. The London Electricity Supply (No. 1) Bill has been approved by the shareholders. The associated companies continue to show satisfactory progress, with improved results and increased dividends. During the year the directors have acquired a controlling interest in other electricity supply undertakings in adjoining areas. Meeting: March 18th.

Cambridge Electric Supply Co., Ltd.

The annual meeting of this company, whose accounts were summarised in our issue of February 22nd (p. 307), was held on February 27th. Sir R. Forsyth Scott, who presided, referred with regret to the retirement of Sir Charles Parsons from the board, and said that the Cambridge Company was one of the first to use his turbine for generating electricity. A total of 2,341,111 kWh had been sold—an increase of 451,708 kWh. The company operated under two Electricity Orders. Under the earlier Order the Cambridge Corporation had the right to take over that part of the undertaking within six months of the end of the present year, and a Committee had been appointed to consider the question. The Corporation could not take over the other part of the undertaking until 1945 at the earliest.

Notting Hill Electric Lighting Co., Ltd.

The annual meeting of the company was held on February 26th, under the chairmanship of Mr. A. E. Franklin. In presenting the report and accounts, which were reviewed in our issue of February 22nd (p. 306), the chairman stated that the outstanding balance of 7½ per cent. seven-year notes was £15,000. The capital expenditure showed items relating to a new 500-kW motor-generator, and new mains and meters. In spite of the reductions of charges to consumers, the revenue showed an increase; further reductions were to be made as from Lady Day which would bring the charges down to within one penny of the pre-war rate. The chairman dealt at some length with the London Electricity Supply (No. 2) Bill, which is being dealt with in the present session of Parliament, and said that, in connection with this Bill, the company had entered into an agreement to lease the Wood Lane station and bulk supply mains to a holding company which would also lease the Central and some other bulk stations, on the condition that current would be supplied at a price not higher than that at which the company would be able to generate electricity itself. The leasing company undertook to discharge the Notting Hill Company's £200,000 of debentures and £100,000 of notes. The maximum capacity of the Wood Lane station had been almost reached, and so the company had arranged to take a bulk supply from the Central Co. on satisfactory terms. There would thus be close co-operation and physical connection between the Westminster Electric Supply Corporation, the St. James' and Pall Mall Co., the Chelsea Co., the Kensington and Knightsbridge Co., and the Notting Hill Co., forming a "West End" group. The report and accounts were adopted, and at a subsequent extra-ordinary general meeting the provisions of the above-mentioned Bill were approved.

Mersey Railway Co.

At the annual meeting, on February 21st, Mr. James Falconer (chairman) said that the net receipts (*vide* ELEC. REV., February 22nd, p. 308) were £2,590 in excess of those of 1922, and as a result of economies the net improvement amounted to £4,826. During 1923 extensions of the automatic signalling system had been carried out on the lines, and further extensions were in hand. The cost of maintenance of the permanent way would be reduced on account of the laying of heavier rail on a portion of the track. Oscillation had been reduced by this and the installation of a guard rail. During the current year it was intended to renew a considerable part of the generating plant. A shareholder said that he thought the time had come when the ordinary stock should receive a dividend, and another considered that the item of £70,000 for wages was too high. The chairman, in reply, said that both rates and wages were fixed, and had to be adhered to. The traffic would have to be greatly increased before the holders of ordinary stock could expect any return. In reply to another question, he said that there were considerable difficulties in the way of a rival tunnel under the Mersey. The report and accounts were adopted.

Llandudno and Colwyn Bay Electric Railway, Ltd.

Mr. A. W. Tait, C.B.E. (chairman), addressing the shareholders at the annual meeting, on March 3rd, said that the company had been harassed by prosecutions by both the municipal authorities concerned with respect to the maintenance of the roadway over which their lines ran. To add insult to injury, the Councils had licensed motor 'buses to run over the same routes in competition with the company's cars. A considerable section of the track was in course of reconstruction, and the line was being doubled. This would decrease maintenance costs in succeeding years. The small balance of profit precluded the declaration of any dividend. They had been unable to persuade the local councils to permit Sunday running, which would enable the company to provide cheaper travelling facilities. The chairman said that a meeting of debenture holders would be held shortly to consider the question of increasing the existing debenture issue. The report was adopted.

Bournemouth and Poole Electricity Supply Co., Ltd.

The report for 1923 shows that the total amount available for distribution (including £9,187 brought forward) was £123,380. From this were deducted: Interest on debenture stock, 7½ per cent. notes, and temporary loans, less income tax, £14,172; leasehold and special redemption funds and interest, £954; reserve for redemption of seven-year notes, £3,000; reserve for depreciation, renewals, &c., £20,000; and general reserve, £55,398; leaving a balance of £34,855. Interim and final dividends on the 4½ per cent. preference and 6 per cent. second preference shares and an interim dividend on the ordinary shares (3½ per cent.) absorbed £14,702, and it is proposed to deal with the remainder (£20,153) as follows: Final dividend of 6½ per cent on the fully-paid ordinary shares (making 10 per cent., less tax, for the year), together with a bonus of 3 per cent., free of tax; and a dividend and bonus at similar rates on partly-paid ordinary shares from the date of allotment, December 31st, 1923, payable on March 21st. This will absorb £12,212, and it is proposed to carry forward the balance of £7,941. It is further recommended that the sum of £60,000, being part of the £91,500 standing to the credit of the reserve fund, be capitalised with a view to the payment of a bonus of 4s. per share on each of the issued ordinary shares, and that this be satisfied by the distribution of one fully-paid £1 ordinary share to holders of every five £1 shares held on April 1st, 1924. The amount of energy sold was 8,117,509 kWh.

Elgin Electric Supply Co., Ltd.

At the second annual meeting, held recently, it was stated that the number of consumers had increased from 33 to 91, and the connections from 23 to 108 kW. The trading for the period had resulted in a net profit of £218, and after making provision of £100 in respect of upkeep of accumulators, there was, with interest on deposit receipt, a sum of £189 to be dealt with. It was recommended that £100 be written off preliminary expenses, and that the balance of £89 be carried forward.

Bruce Peebles and Co., Ltd.

The report for 1923 states that the profit for the year, including interest on investments and transfer fees, and after deducting administrative expenses, amounted to £51,546, to which was added £7,025 brought forward, making £58,571. This is to be allocated as follows: Taxation reserve account, £15,000; depreciation reserve account, £5,000; dividend on preference shares (half already paid), £3,830; further dividend of 2½ per cent., less tax, on preference shares, payable March 31st, £1,277; a dividend of 10 per cent. and a bonus of 5 per cent., less income tax, payable March 31st, £24,369; carried forward, £9,095. The results for the year are considered satisfactory, affected as they were by the fall in output and prices. It is hoped that with the increase in electrical development at home and abroad there will be some improvement in the current year. Meeting at Edinburgh to-day (Friday).

Scottish Power Co., Ltd.

At the annual meeting of the company, on February 29th, the chairman, in the course of his remarks, said that the directors considered that the scheme put forward by the Edinburgh Corporation for the establishment of an electricity district infringed the statutory rights of perpetual tenure of the company, and at the public inquiry before the Electricity Commissioners, in March, 1923, and they were successful in maintaining that the boundaries of the proposed electricity district should be delimited to exclude certain parishes in West Lothian to protect the company's interests.

Scarborough Electric Supply Co., Ltd.

The profit for the year 1923 was £24,431, and to this was added £6,316 brought forward, making £30,747. £7,000 has been placed to depreciation reserve, £3,000 to reserve fund, and £1,810 written off the expenses of the debenture issue. Debenture interest and bank interest absorb £2,955, leaving £15,982. It was proposed to pay a dividend of 6 per cent., free of tax, absorbing £7,742, and leaving £8,240 to be carried forward. The energy sold increased by 89,283 kWh to 2,078,624 kWh, and the number of 30-W equivalent connections by 9,053 to 192,982.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee, under Rule 159:—

North Wales Power Co.—965 ordinary shares of £1 each, fully paid (Nos. 323,001 to 323,965).

Application has been made to the Committee to allow the following to be officially quoted:—

Yorkshire Electric Power Co.—255,000 ordinary shares of £1 each, fully paid (Nos. 830,001 to 1,085,000).

Westinghouse Electric and Manufacturing Co.—At a meeting held last week in New York, the proposal was approved to offer stockholders $17,955,000 additional common stock at $52.50 per share. The directors declared a 10 per cent. stock dividend, as well as the regular quarterly distribution of 2 per cent.—*Financial Times.*

Oxford Electric Co., Ltd.—The balance at credit of profit and loss for 1923 was £35,366, including £2,437 brought forward. The available balance is £28,602, and it is proposed to pay a dividend of 6 per cent. on the ordinary shares, and to transfer £17,000 to reserve and renewal of plant account, carrying forward £2,852.

Telegraph Construction and Maintenance Co., Ltd.—The net profit for 1923 was £128,714. To this was added £114,085 brought forward, making £242,799. The interim dividend of 2½ per cent. paid in July last absorbed £22,410, leaving £220,389. It is proposed to distribute a final dividend of 7½ per cent., free of tax, £67,230; to contribute £30,000 to the reserve fund (making it £240,000); and to carry forward £123,159.

Para Electric Railways and Lighting Co.—The gross receipts for 1923 were £305,780, as compared with £288,737. Operating expenses amounted to £162,831, leaving £142,948, as against £134,805. The net revenue was £30,245, as against £50,715, but after adding interest, &c., and deducting London expenses, income tax, debenture interest, and sinking fund, &c., there was an adverse balance of £15,959.

Direct Spanish Telegraph Co., Ltd.—The payment of the following dividends is recommended for the year 1923, *viz.*, 10 per cent. on the preference shares, less income tax, and 10 per cent. on the ordinary shares, free of income tax. On October 1st, 1923, the dividend on the preference shares for the half-year ended June 30th was paid, and also an interim dividend of 4 per cent. on the ordinary shares.

Tyneside Electrical Development Co., Ltd.—The profit for the year ended January 31st was £3,804, and, adding £624 brought forward, gives an available total of £4,428. A dividend at the rate of 6 per cent. per annum is recommended on the preferred ordinary shares, and 6 per cent. per annum on the deferred ordinary shares. Of the balance, £500 is to be transferred to reserve and £629 carried forward.

Belgian Company.—The report of the Société des Anciens Etablissements Pieper, of Liége, for the year ended October 31st last shows a net profit of only 161,767 fr., as compared with 248,527 fr. in 1922. No dividend has been paid for the past two years.

Stewarts & Lloyds, Ltd.—A final dividend on the deferred shares of 2s. and a bonus of 6d. (making 12½ per cent. for the year, as in 1922) is proposed. £90,000 is set aside for depreciation; £50,000 is transferred to reserve; £10,000 to employés' benefit fund; and £100,000 is to be carried forward.

Eastern Telegraph Co., Ltd.—Final dividend of 2½ per cent., free of tax, on the ordinary stock, making 10 per cent., free of tax, for the year, as in 1922. This dividend and a dividend at the rate of 3½ per cent. on the preference stock for the first quarter of 1924 will be paid on April 15th.

Prospectus.—*Electrical Distribution of Yorkshire, Ltd.*—The company is offering to its shareholders (until March 29th) 100,000 ordinary shares of £1 each, ranking *pari passu* with the shares already issued, and conditionally allocated *pro rata*, at the price of 25s. per share.

Western Telegraph Co., Ltd.—Second quarterly interim dividend of 5s. per share, free of income tax, has been declared for the year ending June 30th, 1924, payable on March 25th, being at the rate of 10 per cent. per annum.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Final dividend of 5s. per share, free of tax, payable April 15th.

Manila Electric Corporation.—A dividend of 2 per cent. has been declared upon the common capital stock for the quarter ending March 31st.

Tucuman Tramways, Light and Power Co., Ltd.—In the Chancery Division, on Tuesday (March 11th), Mr. Justice Eve had before him the petition of this company for the sanction of the Court to a reduction of its capital. Mr. Turner, for the company, said it was proposed to write down the 100,000 deferred shares from £1 each to 10s. because of capital which had been lost. There had been separate class meetings of shareholders, and the reduction had been approved. His Lordship sanctioned the reduction.

Stocks and Shares.

MONDAY EVENING.

THE general condition of Stock Exchange markets remains tolerably firm, in spite of the fresh plight into which the Paris exchange has fallen. The slump in the franc affects many hundreds of stocks and shares either directly or indirectly, though the fact of the fall having been to some extent anticipated, causes the effect of the drop to be less severe than might have been the case had it come without warning. British Government stocks, the prices of which influence investment securities of all kinds, keep their levels with greater firmness than might have been expected, and the manner in which they resist extrinsic factors exerts a salutary effect upon securities as a whole.

The electricity supply market is remarkably free from the unfavourable circumstances, of which the fall in the franc is the most depressing. A number of prices are ex dividend

in the list of ordinary and preference shares, the deductions in several cases having already been partially recovered. County of London ordinary shares rose sharply to 48s. 6d., upon talk of a possible bonus to be given to proprietors in the shape of new shares for nothing. Some said there would be one new share for every three old, others that there would be one new share for five old. If there is anything in this gossip, no doubt it will be made known during the present week. The company's report, which says nothing of a new issue of shares, shows steady expansion, and there is plenty of scope left for further development.

Bournemouth and Poole rose to 48s. 6d., on the announcement that one new share is to be given for every five old. South Londons are a good market at 42s. 9d., showing a rise of 1s. 6d., though rumour has so far left this company alone. Charing Cross ordinary at 2¼ are quoted in their new £1 shape, as are also the preference at 17s. Talk of an amalgamation between two or more of the West End companies has been heard in the market.

To give some idea of the greatly increased attention which is being paid to electricity supply shares, we may mention that a well-known firm of Stock Exchange jobbers considers it worth while to issue a small brochure entitled "The Electrical Industry: Position and Prospects." The book points out that even with a handicap of well-intentioned but misguided legislation, the electrical supply industry of Great Britain has grown from almost negligible proportions, thirty years ago, to such an extent that it now represents an investment of about 190 million pounds. The envoi of the booklet is that there are wide prospects for development in all applications for electricity, and that it has before it a permanent field of usefulness, unlimited in extent, both in this country and abroad.

British electrical manufacturers, the firm concludes, are competing successfully in the world's markets. Justification for this last sentence can be seen almost every day in the announcement of substantial contracts secured by well-known British firms, details of which serve to keep the market in the shares very steady. The Aron Electricity report is excellent, but has had no effect upon the prices of the ordinary and preference, which remain at 8s. 6d. and 22s. 6d. respectively. At the Midland Counties Electric Company's meeting, the chairman referred to the great strides made by the supply side of the business. The remaining 250,000 preference shares are to be issued at the first favourable opportunity.

The electrical manufacturing companies are looking forward with a good deal of hopefulness to the business they will secure from the electrification of the bigger railway lines. The Southern Railway, at its meeting the other day, announced an extremely comprehensive policy in this respect, and the other "steam" brethren will follow suit. At the meeting of the Underground Electric Railways on Thursday in last week, Lord Ashfield rather disappointed his hearers by stating explicitly that there is no immediate prospect of reorganisation of the company's finances. The chief obstacle, as pointed out previously in these paragraphs, lies in the fact that the Underground Company's Income Bonds are repayable, not only as to the coupons, but as to the principal as well, in New York currency. With the dollar rate so much against this country, as it is now, any conversion or repayment of the Incomes would be a costly business. Home Railway stocks are steady, but there is not much doing in them, the ordinary investor being rendered chary of touching them owing to the incessant labour agitations. The South Metropolitan Electric Tramways and Lighting Company declares a 5 per cent. dividend on its ordinary shares. The Metropolitan Electric Tramways report shows that after deduction of fixed charges and appropriations, there remains £2,804, which is carried forward to the next accounts.

Marconis have drooped to 35s., amidst the volleys of correspondence that have followed publication of the Imperial Wireless Telegraphy Committee's report. The Stock Exchange view seems to be that the recommendations are likely to be adopted, with slight modifications, and that this will be to the advantage of the company, in enabling it to go ahead with its own work, unfettered by complications with the Government. The cable group is firm, with scarcely a movement throughout the catalogue. Chili Telephones are 8s. 9d. up at 6¼. Other stocks maintain their prices. The Direct Spanish Telegraph Company will pay 10 per cent. free of tax on its ordinary shares.

British Columbia Electric new tax-free debenture has risen to 7 premium, and the company's older stocks have recovered from the heaviness induced by the competition of the newcomer. Anglo-Argentine Seconds are ⅛ better at 2 15/16. Mexico Tram fives fell 2 points to 74, because of the latest breakdown of negotiations for the recognition of Mexico. Brazilian Tractions are ¼ higher.

Edison 5 per cent. debenture stock shows a gain of 2 points. General Electric first and second preferences are better at 23s. 3d. and 22s. 3d. respectively. The Telegraph Construction Company maintains its usual dividend, causing the price to rise 10s. Improvements are to be noted in British Aluminium, Electric Construction, English Electric and Siemens. Babcock & Wilcox are a shade better at 47s. bid, but the iron and steel group is disposed, as a whole, to dulness. Rubber shares are unable to escape from the stagnation imposed upon them by the want of resiliency in the price of the raw material.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom.	Dividend. 1922.	Dividend. 1923.	Price Mar. 10. 1924.	Rise or fall.	Yield. p.c.
Brompton Ordinary	£ 1	12	10	38/9	— 1/16	*£5 3 3
Charing Cross Ordinary	1	14	14½	2¼xd	—	5 0 0
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6 0
Chelsea	1	10	12	38/9	—	5 3 2
City of London	1	15	15	48/3xd	—	6 4 4
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
County of London	1	10	15	2 1/16	+ ⅛	6 2 6
do. do. 6 % Pref. ...	1	6	6	23/3	+9d.	5 3 3
Edmundson's Ordinary	3	7	7	4 1/16	+ 1/16	5 3 4
do. 6 % Pref.	5	6	6	4¼	—	6 3 0
Kensington Ordinary	—	12	14	10½	—	6 13 4
London Electric	3	10	10	4¼xd	—	6 6 5
do. do. 6 % Pref. ...	5	6	6	5¼xd	+ ⅛	5 9 1
Metropolitan	1	8½	10	12xd	+ 1/16	5 14 9
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	2½	6	18/9	—	6 8 0
do. 5 % Pref. ...	1	5	5	16/3	—	6 3 1
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	—	—	17/6	—	Nil.
do 6 % Pref. ...	1	5	5	17/6	—	6 17 2
St. James' and Pall Mall ...	5	14½	17½	12 1/16xd	—	6 17 2
South London	1	11	15	42/9	+ 1/16	7 0 2
South Metropolitan Pref. ...	1	7	7	23/9xd	—	5 18 0
Westminster Ordinary	5	12	15	10 1/16xd	—	7 2 10
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	19/6	—6d.	7 13 10

Home Rails.

Central London Ord. Assented Stock	4	4	68½	—	5 16 10
Metropolitan ... ... ,,	3½	4	75½xd	—	5 6 0
do. District ... ... ,,	3	3½	53½xd	—	6 10 10
Underground Electric Ordinary	10	Nil	Nil	2 1/16	— ¼	Nil
do. do. "A" ...	1	Nil	Nil	8/-	—	Nil
do. do. Income Bonds	5	6	100	—		*£6 0 0

Telegraphs and Telephones.

		Dividend. 1921	Dividend. 1922			
Anglo-Am. Tel. Pref.	Stock	6	6	103	—	5 14 9
do. Def.	,,	1½	34/6	22½	—	6 13 4
Chile Telephone	5	6	6	6¼	+ 1/16	4 16 0
Cuba Sub. Ord.	10	7	7	7½	—	9 13 2
Eastern Extension...	10	10	10	10⅝	—	5 18 6
Eastern Tel. Ord.	Stock	10	10	108½	—	5 18 8
Globe Tel. and T. Ord.	10	10	10	17½	—	5 16 0
do. do. Pref.	10	6	6	10⅝	—	5 19 4
Great Northern Tel.	10	24	22	38	—	7 16 9
Indo-European	25	10	7	32½	—	*5 7 8
Marconi	1	25	15	1¾	— 1/16	8 11 6
Oriental Telephone Ord.... ...	1	12	12	1¾	—	*6 8 0
United R. Plate Tel.	5	8	8	6⅝	—	*5 16 6
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	16⅞	—	6 0 1

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref....	5	5½	12½	3 1/16	—	8 6 0
do. do. 2nd Pref. ...	5	Nil	8½	2 1/16	+ ⅛	10 4 4
do. do. 5% Deb. ...	Stock	5	5	75	+1	6 13 4
British Electric Traction Ord. ...	,,	4½	5	72	—	6 19 0
do. do. 6% Pref. ...	,,	6	6	98½	—	6 1 10
Brazil Traction	100	Nil	4	59½	+ ⅛	6 14 6
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	84½	—1	5 18 4
do. do. Preferred	,,	5	96/-	80½	—	*5 11 6
do. do. Deferred	,,	8	127/-	101½	—	*6 8 0
do. do. Deb.	,,	4½	4½	76½	—	5 11 1
Lond. & Sub. Trac. 5 % Pref. ...	1	8½	5	6/- xd	—	8 6 8
London United Tram. Deb. ...	Stock	4	4	54	—	7 8 2
Mexico Trams. 5% Bonds ...	—	Nil	Nil	74	—	6 11 6
do. 6% Bonds ...	—	Nil	Nil	58½	—	Nil
Mexican Light Common ...	100	Nil	Nil	23½	+1	Nil
do. Pref.	100	Nil	Nil	48½	—	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6 0

Manufacturing Companies.

Babcock & Wilcox...	1	15	20	47/-	—	*4 5 4
British Aluminium Ord.... ...	1	10	5	22/6	+6d.	4 8 10
British Insulated Ord.	1	15	15	2½	—	6 0 0
Callenders	1	15	15	49/3	—	6 4 6
do. 6½ Pref....	1	6½	6½	24/3	—	5 7 2
Crompton Ord.	1	10	5	⅜	—	10 0 0
Edison-Swan	4/-	10	Nil	4/9	—	6 6 4
do. ,, 5% Deb.	Stock	5	5	77½	+2	6 9 0
Electric Construction	1	10	10	1 1/16	+ 1/16	6 7 6
English Electric	1	8	5	17/9	+3d.	5 12 2
do. do. Pref.	1	6	6	1	—	6 0 0
Gen. Elec. Pref.	1	6½	6½	23/3	+9d.	5 11 10
do. Ord.	1	10	5	20/3	—	4 19 0
Henley	1	15	15	2¾xd	—	6 6 4
do. 4½ Pref.	5	4½	4½	4½	—	5 9 1
India-Rubber	1	10	10	⅞	—	*6 13 4
Met.-Vickers Pref....	2	8	8	2 1/16	—	6 5 0
Siemens Ord.	1	10	10	17/1	+9d.	Nil
Telegraph Con.	12	20	20	24½	+ ½	*4 18 8

* Dividends paid free of Income Tax.

The Design of Apparatus for a.c. Circuit Protection.

By A. S. FITZGERALD, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from p. 396*).

There is scope for improvement in performance in many instances and, by the employment of the biasing transformer, this may be achieved with freedom from additional complication. An equivalent protective circuit to that outlined in fig. 2 (last issue) is shown in fig. 4. In order that the operating winding shall continue to receive the true difference current, the restraining winding must be symmetrically disposed with regard to it, and accordingly one end of the former is taken to a mid-point on the restraining winding. This modification endows the protective circuit with the characteristics shown in fig. 5, which gives the relation between the current in the restraining winding (that is to say, the transmitted load or "through current"), and the operating excitation. It shows the difference or fault current necessary to cause the relay to trip and the actual magnitude of restraint that can be achieved under these conditions. The actual value attained will depend on the number of turns on the restraining coil, and a restraining action of the full extent indicated may not, in every instance, be necessary. The biasing transformer provides a further advantageous feature not usually inherent in systems employing biased relays. Under normal circumstances, when the transmitted load and, accordingly, the restraining current, is of no very great magnitude, the presence of the air-gap will materially reduce the restraining effect, causing a very marked increase in the reluctance of the magnetic circuit carrying the restraining flux. When, however, due to remote faults or overloads, the restraining excitation is capable of saturating the core of the biasing transformer, the effect of the air-gap will be very much less, in fact almost inappreciable, since the permeability of the core itself in this state will more nearly approximate to that of an air path. The upper curve in fig. 5 indicates the characteristics of a biasing transformer in which the central member is not furnished with an air-gap, whilst the lower curve corresponds to the provision of a suitably designed magnetic circuit in which this feature is present.

Thus it is possible to arrange that the inherent sensitivity of the protective circuit shall not be impaired by the presence of the restraining effect until the transmitted load or fault current considerably exceeds the rated load of the unit protected.

As the biasing transformer will have a magnetic circuit of restricted cross-section, this will become saturated by operating current alone when it exceeds, to any great extent, the value necessary to affect tripping of the relay, even though the restraining winding is not energised. The secondary output will therefore be correspondingly limited, as will also the maximum force which may be developed in any relay operated by the biasing transformer, no matter to what magnitude the fault current may increase.

It has been demonstrated that, in the matter of current-transformer balance, ample restraint may be applied without more than a small fraction of the maximum possible effect being brought into use. Biasing transformers render possible the use of a very much more sensitive relay.

In many systems, notably the protection of parallel circuits, a more extended function is required. The simplest case is that of direct balance between two feeders, when two simple mechanically-balanced relays of the beam type might be used.

An analogous scheme in which ordinary relays and biasing transformers are substituted for the balanced relays, no other change being made in the connections, gives similar performance, as will be understood by reference to further characteristic curves in fig. 6, which shows curves connecting relay current with operating current, a restraining current having direct proportional relation to the operating current being simultaneously present. Each curve refers to a different ratio between operating and restraining excitation.

The arrangement shown in fig. 7 gives both discriminating and overload restraint. The current transformers and restraining windings are connected so as to form a circulating-current circuit having equi-potential points across which the two operating windings are connected in series. The restraining windings are cross-connected.

The biasing transformers associated with the sound line have equivalent operating and restraining currents and will, in accordance with curve (*a*) in fig. 6, remain inoperative. The transformer controlling the other relay, whilst receiving the same operating current, will be unrestrained and will therefore trip. Circulating-current circuits operating on the above principle may be arranged for protecting any number of parallel circuits.

Directional discrimination usually makes use of one of two operating principles, one of which involves the vectorial addition or subtraction of electrical effects set up respectively by current and potential excitation, some means being devised for arranging that neither current nor potential alone can effect operation of the relay. The principle has been applied by the use of the biasing transformer in lieu of balanced-beam relays controlling a simple relay in an analogous manner. Whilst this principle is not capable of quite the degree of precision attainable with the dynamometer type, it is thought to possess some sphere of usefulness.

The application of the apparatus dealt with above to various protective circuits is next described in greater detail. With regard to the provision of a biased form of split-conductor protection it is explained that a scheme that is particularly suitable for e.h.p. application employs ring-type cores through-

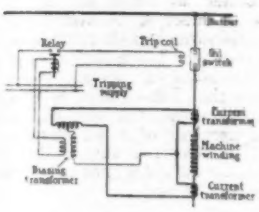


Fig. 4.—Application of Biasing Transformer to Circulating-Current Circuit.

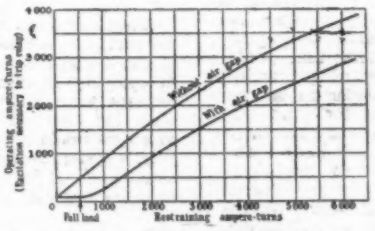


Fig. 5.—Characteristic Curve of Biasing Transformer; Overload Restraint.

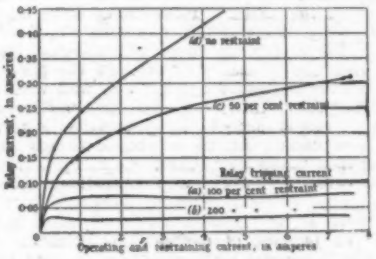

(a) no restraint
(c) 50 per cent restraint
Relay tripping current
(a) 100 per cent restraint
(b) 100 "
Relay current, in amperes
Operating and restraining current, in amperes

Fig. 6.—Characteristic of Biasing Transformer; Discriminating Restraint.

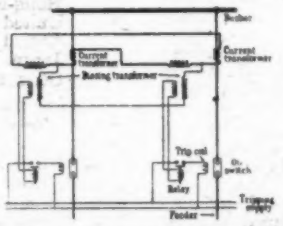


Fig. 7.—Improved Discriminating Circuit.

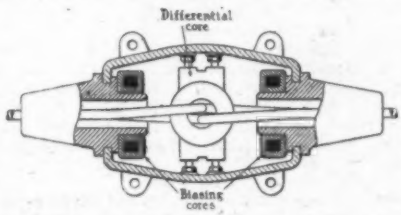


Fig. 8.—Self-Biasing Ring-Core Split-Conductor Transformer.

out. A simple differential core only excited by a fault current, exactly as in the ordinary arrangement, is used. The secondary excites the relay through the medium of a biasing transformer of the type illustrated in fig. 1 (*a*). The operating excitation sets up fluxes in the rings in opposite directions, while the primary windings passing through the biasing cores magnetise them in the same sense. Thus they have no inductive effect on the relay, and on heavy overloads they will act as restraining windings. Fig. 8 shows how such a transformer might be constructed, the biasing cores being arranged on each side of the differential core.

The advantages of using biasing transformers are:—(1) Any type of relay may be used. (2) A single type of simple relay may be used for any of the systems of protection described. (3) Different forms of biasing transformer may be made of standard components. (4) Transformer-operated relays are not disturbed by stray direct currents. (5) The relay is protected from mechanical damage due to heavy faults. (6) The apparatus requires minimum attention. (7) Static discriminating apparatus is not likely to deteriorate under service conditions.

The advantages of separate line and earth settings are:—(1) Sensitive operation on earth faults is more easily achieved. (2) Sensitively set relays are not disturbed by short-circuit currents. (3) The effects of load currents are more easily avoided. (4) Small "tee" loads on protected feeders are possible without interfering with protective arrangements.

The British Thomson-Houston Co. has subjected all the devices described in the paper to such tests under service conditions, and also at the factory, as are essential to prove their practical capabilities, and exhaustive experiments have been carried out on each of the complete protective circuits, special arrangements having been made to simulate the various service conditions which it has been possible to foresee and reproduce.

Of the eight principal systems of protection described, actual equipment has been supplied except in the cases of two systems, in lieu of which other methods described in the paper are available.

The author illustrated his paper with numerous lantern slides, showing various types of protective circuits, different patterns of biasing transformers, and views of the latter as installed at the open-air h.p. High Street sub-station of the Manchester Corporation.

Discussion in London.

CAPT. J. M. DONALDSON, M.C., opened the debate by remarking that to the making of relays there was no end, and that such things were not for universal usage. The introduction of protective gear might sometimes introduce another weak link in the chain. Pilot cables were expensive, and might either give a false sense of security, or, if a faulty, would cause the gear to operate when it should not. It might be possible to circulate a small d.c. through the pilot cables in order to afford an indication that all was well with them; that would, at the same time, increase the sensitiveness of the relays, but it might make them so sensitive as to render the scheme impracticable. All those kind of things made for complexity and also potential trouble. Capacity current was not always the cause of faulty relay operation. He had known two identical systems, under exactly similar fault conditions, operate in an opposite manner; the cause being difference in the balance of current transformers. If, therefore, the author's method made available another type of transformer which would avoid the above-mentioned trouble, it would merit consideration and justify the somewhat more complication involved. Moreover, if it avoided the use of pilot sheaths, which were expensive, he might be prepared to become enthusiastic. There was bound to be an occasional breakdown on every system, and he, therefore, pleaded for simplicity and for the fault current to be allowed "to do its own job instead of making its little brother actuate some subsidiary device as a means to the same end." There was a very good device on the market which met those conditions.

Mr. K. EDGCUMBE remarked that the main difficulty was the enormous range of current that had to be dealt with, but there were more ways than one of overcoming it. Why not attack the current transformers with a view to improving balance, increasing ampere-turns, and making them do as little work as possible? Why did they measure two large quantities in order to arrive at the difference instead of measuring the difference direct with the aid of the transformers? The author's method of indicating the windings of his biasing transformer (fig. 2 in his paper) was simple enough, but his wiring diagram of a balanced-current system with stand-by protection for a single line (fig. 42 in the paper) showed the biasing transformers encased in a tank so that their number was hidden. Was not the number excessive? Even their fixed windings might give trouble. Fig. 7 (overleaf) illustrated an extremely good arrangement, but while the author's suggestions might be suitable in some cases, they were not in all.

Mr. J. R. COWIE agreed with the advocacy of single-primary transformers; the proper place to obtain balance was in the transformer itself, and that could be done and would give better results. Parallel-feeder protection was fundamentally wrong, because the relays depended on the power current. The split-conductor method was the most stable and sensitive, and he (the speaker) had yet to learn of its incorrect operation on "straight through" currents. The use of the author's device on split-conductor systems appeared to be adding an excrescence. The demand for sensitive setting was a retrograde step. Incipient faults must be located, not hidden, by gear installed to deal with them. The author had done well but the main usefulness of his suggestions would be found in older systems which had grown faulty.

Mr. R. W. BILES pointed out that more pains should be taken to measure the ohmic resistance at remote ends of a system; bonding was also important, and he favoured earthing without resistance. The balancing of transformers was not difficult, and he claimed that the diverter-relay system (referred to by Mr. H. W. Clothier at the Newcastle discussion, as reported last week) would do all that the author claimed and with simpler connections.

Mr. H. TRENCHMAN, who repeated many of the observations he had made in the Newcastle debate, explained that large expenditure on switchgear was made necessary by the fact that phase-faults had to be guarded against. If they could legislate for earth faults alone, that expenditure could be reduced and a determined effort was being made to do so. Credit should be given for the fact that switchgear which bid fair to achieve that aim and make phase-to-phase faults practically impossible had been built in this country. Protective gear seemed to have a bad name with the user, yet the need for it was proved by the fact that it was continually being installed. It was, however, not treated properly, and not given the attention it deserved.

Mr. C. L. LIPPMAN wanted to know how the author would apply his system in the future when the transmission pressure would be considerably increased and the transformer primary would be too small to be of real use. It was better for a relay to be designed for each particular job, and the author's method should be applied only where it was really useful and not pushed too far.

Mr. G. W. PARTRIDGE said he would have thought it equally necessary to have as sensitive devices for line-fault settings as for earth-fault settings. Engineers deprecated the use of large numbers of relays, yet no alternatives were available.

Mr. A. S. FITZGERALD, in his reply, pointed out that he had endeavoured to take a detached attitude, and had not been anxious to discuss too much the fitness or desirability of the various systems described. He had merely endeavoured to show how existing systems could be carried out in what he thought to be, in many cases, a better way. It was necessary to differentiate between complication in the idea and in the concrete case, or in his welded sheet-iron case. He did not see how it was possible to improve the balance of ordinary current transformers, and it was not economical to do so. He considered five static windings were better than one moving part. The split conductor system without the biasing feature had given satisfaction, but there was a necessity for good joints. It was better to avoid the trouble of balancing, and to take steps to meet it between split conductors. The necessity for balancing transformers arose out of the demand for sensitive setting. There was no difficulty in applying his method at high pressure, provided the transformers were made large enough. The design of a special relay for every different function was not wanted, because to do so would increase the problem of maintenance. Mr. Biles's system seemed to be "a retrograde step in the wrong direction." It involved a number of extra moving parts and required a special arrangement of relays.

Import Trade of Siam.

THE following figures, showing the imports of electrical and similar goods into the port of Bangkok during the year ended March, 1923, are taken from the recently-issued official trade statistics; the figures for the year ended March, 1922, are included for purposes of comparison, and notes of any increases or decreases are given. Imports stated to be from Singapore and Hong-Kong are for the most part the products of other countries shipped *viâ* these two ports:—

	1921-22. Ticals.	1922-23. Ticals.	Inc. or dec. Ticals.
Lamps.—			
Total	213,000	300,000	+ 87,000
From Singapore	56,000	66,000	+ 10,000
,, Hong-Kong ...	11,000	23,000	+ 12,000
,, United Kingdom ...	22,000	39,000	+ 17,000
,, United States ...	72,000	19,000	− 53,000
,, Japan	46,000	84,000	+ 38,000
,, Germany	3,000	58,000	+ 55,000
Electrical goods and apparatus.—			
Total	1,325,000	798,000	− 527,000
From United Kingdom ...	472,000	307,000	− 165,000
,, Germany	37,000	87,000	+ 50,000
,, United States ...	350,000	142,000	− 208,000
,, Singapore	26,000	24,000	− 2,000
,, Sweden	237,000	42,000	− 195,000
,, Italy	5,000	16,000	+ 11,000
,, Holland	31,000	47,000	+ 16,000
,, France	13,000	11,000	− 2,000
,, Japan	102,000	60,000	− 42,000
Manufactures of copper.—			
Total	42,000	58,000	+ 16,000
From Hong-Kong ...	3,000	6,000	+ 3,000
,, United Kingdom ...	25,000	39,000	+ 14,000
,, India	5,000	4,000	− 1,000
,, Germany	3,000	5,000	+ 2,000
Scientific instruments and apparatus.—			
Total	292,000	276,000	− 16,000
From United Kingdom ...	116,000	118,000	+ 2,000
,, Germany	6,000	28,000	+ 22,000
,, France	31,000	5,000	− 26,000
,, Japan	31,000	28,000	− 3,000
,, United States ...	56,000	16,000	− 40,000
,, Denmark	15,000	41,000	+ 26,000
Prime movers, other than locomotives, marine, military, and agricultural machinery.—			
Total	558,000	470,000	− 88,000
From United Kingdom ...	450,000	309,000	− 141,000
,, United States ...	42,000	135,000	+ 93,000
,, Germany	17,000	21,000	+ 4,000

	1921-22. Tcals.	1922-23. Tcals.	Inc. or dec. Tcals.
Machine tools.—			
Total	193,000	150,000	– 43,000
From United Kingdom ...	146,000	117,000	– 29,000
„ United States ...	30,000	4,000	– 26,000
„ Denmark	8,000	21,000	+ 13,000
Machinery, unenumerated, including detached parts, and not including agricultural, textile, or sewing machines.—			
Total	1,028,000	779,000	– 249,000
From United Kingdom ...	733,000	443,000	– 290,000
„ Japan	5,000	5,000	—
„ United States ...	99,000	120,000	+ 21,000
„ France	51,000	14,000	– 37,000
„ Denmark	31,000	41,000	+ 10,000
„ Germany	52,000	48,000	– 4,000
Iron and steel wire and manufactures thereof.—			
Total	97,000	175,000	+ 78,000
From United Kingdom ...	40,000	123,000	+ 83,000
„ Germany	22,000	94,000	+ 72,000
„ United States ...	8,000	1,000	– 7,000
Railway material.—			
Total	4,143,000	1,375,000	–2,768,000
From United Kingdom ...	1,311,000	742,000	– 569,000
„ United States ...	2,791,000	5,000	–2,786,000
Cars or trucks for railways or tramways.—			
Total	469,000	840,000	+ 371,000
From United Kingdom ...	463,000	692,000	+ 229,000
„ United States ...	2,000	17,000	+ 15,000
„ Belgium	—	111,000	+ 111,000
Rubber manufactures, other than tires.—			
Total	157,000	214,000	+ 57,000
From Singapore	106,000	68,000	– 38,000
„ United Kingdom ...	33,000	40,000	+ 7,000
„ United States ...	3,000	5,000	+ 2,000
„ Japan	7,000	12,000	+ 5,000

NOTE.—£1 = about 13 Tcals.

Tramways and Light Railways in 1922-23.

THE annual report upon tramways and light railways (street and road) and railless trolley undertakings for the year 1922-23, has just been issued (H.M. Stationery Office. Price 15s. net).

The report covers the working of 245 undertakings, of which 169 are owned by municipal authorities and the remainder by companies. During the year the Folkestone, Sandgate, and Hythe Tramway and the Taunton Tramway ceased running, the Oldham, Ashton, and Hyde undertaking was purchased by the respective local authorities, and the Airdrie and Coatbridge Tramways Trust was purchased by Glasgow Corporation.

The total route mileage open for traffic at the close of the year was 2,594 miles, of which 1,788 miles was worked by local authorities and 806 miles by companies. All but an insignificant portion of this mileage was electrically operated; it is of interest to note that a length of over six miles is still devoted to horse traction; steam traction was employed on over 12 miles of route. The total route-length as compared with 1921-22 showed an increase of about 16 miles.

A total of 4,349,041,241 passengers were carried during the year; this represented an increase of 92,772,549, or 2.18 per cent. The car-mileage increased by 19,830,368) (5.97 per cent.) to 351,910,233. Of the last total 348,126,090 car-miles, or 98.92 per cent., were electric car-miles.

The amount of energy consumed increased in greater proportion, by 47,630,311 kWh (8.02 per cent.) to 641,251,511 kWh, raising the consumption per car-mile to 1.84 kWh as compared with 1.82 kWh in 1921-22.

Turning to the financial part of the report it is seen that the total gross receipts in 1922-23 were £31,264,141, as compared with £32,523,339 in the preceding year. The working expenses, however, fell to a greater extent—from £26,835,292 to £24,831,523, improving the gross profit by £1,744,571 to £7,432,618.

After adding income from other sources and excluding lessors' returns there was a balance of £8,059,692 available for distribution as compared with £6,467,572 in 1921-22. The way in which this was distributed was as follows, the allocations for the previous year being shown in parentheses: Interest or dividend, £2,222,454 (£2,142,998); repayment of debt or sinking fund, £1,639,859 (£1,478,286); rent and other charges, £332,292 (£331,306); reserve and renewal funds, £2,635,160 (£1,520,852); relief of rates, £148,126 (£172,687); income tax, £461,748 (£657,923); other purposes, £395,307 (£285,995); carried forward to next year, £224,806 (£122,475).

Of the 169 tramways owned by local authorities, 157 were earning income in 1922-23. The report divides these into six classes according to the financial position at the end of the year. Class 1 consists of undertakings which showed a credit balance for the year, after meeting all charges, including capital redemption and reserves. This group increased in number from 81 to 93, showing a final balance of £461,295, as compared with £296,649 in 1922. The second class met all charges, including capital redemption, but made reserves in excess of the amount available from the year's working. There were seven of these undertakings as against nine in the previous year, and their combined debit balance was £10,676 (£27,392). Class 3, comprising 14 undertakings, as in the preceding year, was unable to meet income tax and other appropriation charges in full, to the extent of £45,150, as compared with £263,124 in 1921-22. Class 4 (27 undertakings as against 30) was unable to meet capital redemption in full, the deficiency being £62,695 (£76,398). Undertakings in Class 5 (10 as against 9) were unable to meet interest charges in full to the extent of £58,106 (£70,210), and those in Class 6 did not earn sufficient revenue to cover their working expenses. The last class numbered six, as compared with 14 in the previous year, the total deficiency being £61,565 £114,507). The combined financial result was favourable, there being a credit balance of £223,103, whereas in 1921-22 there was a balance of £254,982 in the other direction.

The total capital expended upon tramway undertakings increased from £85,908,610 in 1921-22 to £89,090,504, and the number of cars from 14,126 (226 non-electrical) to 14,286 (46 non-electrical).

The analysis of receipts and expenditure per car-mile shows that the gross receipts of the local authorities were 20.99d. as compared with 22.93d. in 1921-22; the companies' gross receipts fell from 26d. to 22.83d.; as a whole there was a fall from 23.51d. to 21.32d. The gross working expenditure showed the following decreases: Local authorities, from 19.10d. to 15.99d.; companies, from 20.66d. to 17.44d.; and as a whole from 19.40d. to 16.25d.

From another statement it is gathered that municipal tramways were aided by the rates to the extent of £271,339, while they contributed £150,247 to the aid of the rates—an adverse balance of £121,092. In the previous year £371,303 was taken from the rates, and £174,738 contributed thereto, making the net amount of aid received £196,565.

Detailed statistics of the amounts expended by municipalities and companies appear in the report. The London County Council, with an expenditure of £16,326,430, is easily the most important in the list. Glasgow Corporation has expended £5,296,552, Manchester £2,925,301, Birmingham £2,760,045, Edinburgh £2,450,077, Liverpool £2,375,802, and the County of Middlesex £2,023,118. The largest company undertaking is the London United Tramways,, Ltd., with an expenditure of £2,563,962. This is closely followed by the Bristol Tramways & Carriage Co., Ltd. (£2,154,636), and the Metropolitan Electric Tramways, Ltd. (£2,037,914).

Tables showing the receipts, expenditure, and allocation of profits for every individual undertaking occupy considerable space in the report. These form a useful work of reference, but it is not possible to give any adequate review of them. More information is to be gained from the car-mileage analysis of these figures. It is seen that the traffic revenue of local-authority undertakings varied from as low as 12.82d. per car-mile (in the case of Barrow-in-Furness), to as high as 30.59d. (in the case of Morecambe). The total, as stated above, was 20.99d. per car-mile. As regards the companies the difference is even more striking, the lowest figure being that of the Aberdeen Suburban Tramways Co. (12.42d.), and the highest that of the Plymouth, Stonehouse, and Devonport Tramways Co. for nine months only (36.75d.). This takes no account of the Hartlepools system leased to the West Hartlepool Corporation, which had the abnormal revenue of 115.8d. per car-mile. The total traffic revenue of the companies was 22.83d. per car-mile.

The longest distance for a penny fare was given by the Bolton Corporation with an average of 1.55 miles; Liverpool with 1.5 miles for a penny was easily second. Two municipal authorities allowed a distance of only .43 mile for a penny.

Separate statistics are given relating to railless trolley undertakings. Of the 29 local authorities which have obtained powers to work railless trolley systems, ten actually carried passengers. Birmingham Corporation commenced to work its system in November, 1922, and the powers of the Western Valleys (Monmouthshire) Railless Electric Traction Co. lapsed during the year. Only one company undertaking, that of the Mexborough & Swinton Co., operated during the year. The total capital expenditure up to end of the year covered by the report was £295,419, of which expenditure by local authorities accounted for £278,508. The route mileage worked showed a slight increase from 47 miles 9 chains to 47 miles 68 chains. The car miles run increased from 1,374,444 to 1,602,438, and the number of passengers carried from 9,879,730 to 11,803,447. The financial statistics show that the municipal undertakings earned gross receipts totalling £95,453, and the company earned £4,777, making a total of £100,230. The working expenditures were £93,760, £5,811, and ££99,571 respectively. Thus, while the municipalities had net receipts of £1,693, the company incurred a loss of £1,034. The traffic revenue per car-mile amounted in the case of local-authority undertakings to between 12.72d. and 21.18d. The company's revenue was equal to 11.82d. The working expenses, including power, varied from 8.85d. to 27.23d. per car-mile for the municipal systems, and amounted to 11.93d. in the case of the company.

Railless trolley undertakings (two) received aid from the rates amounting to £4,134, and (one) contributed £1,862 to rate relief.

Transmission Problems.

The Hexaphase System.

By Major A. M. TAYLOR, M.I.E.E., M.Am.I.E.E.

(Abstract of lecture delivered before the South-Midland Centre *of the* Institution of Electrical Engineers *at Birmingham.)*

At the present moment 33,000 volts is the limiting voltage with 3-phase cables which has had a trial for any extended period, and on any large scale, in this country. The "Hexaphase" system has been so designed that voltages of the order of 120/150,000 can be utilised with underground cables, without the maximum stress on the insulation of 120,000-volt cables reaching appreciably higher values than now obtain on 33,000-volt transmission lines, or, in the case of 150,000-volt cables, than would obtain in 55,000/60,000-volt systems employing 3-phase cables.

It has to be borne in mind that an ordinary system operating at, say, 55,000 volts will—other things being equal—require from seven to eight times the amount of copper that one operating at 150/160,000 volts will require. This, however, is an under statement of the case, because the accommodation required for eight times the number of cables in the streets is a very serious matter and results in the necessity for employing "nests" of cables laid in ducts; this, again, greatly reduces the current-carrying capacity of the cables, so that even the above ratio does not by any means properly represent the disparity between the two systems.

The employment of single-core cables will, the author believes, undoubtedly be a step in the right direction and will permit of the restriction of 3-phase cables of the ordinary type to that very large sphere of work where the necessities of transmission, or distribution, do not require a voltage exceeding 30,000/60,000 volts; but even this does not permit of raising the voltage above 100,000 for a 3-in. diameter cable.

In a lecture delivered before the Junior Institution of Engineers (*Transactions*, Vol. 34, Part 2 (fig. 4), November, 1923) the author has shown that by the employment of intersheaths an actual advantage in the use of insulation can be effected, enabling, for a given depth of insulation, *over 50 per cent. more voltage to be employed* than in the case of a plain single-core cable. Hence, the 100,000 volts become 150,000 volts for a 3-in. cable, and 50 per cent. more voltage means halving the total amount of copper required.

In any comparison of the "Hexaphase" system with a system employing single-core cables (the only alternative left), it has also to be borne in mind that the reliability of working is very greatly increased, a point of supreme importance which, it may be, is not sufficiently realised, except by those who are actually in daily association with a 33-000-volt system running in conjunction with a super station. The "Hexaphase" system employs triple-concentric cables, and of these the outermost cores of each cable are the most difficult to insulate and the most likely to break down. When, however, a breakdown does occur, the shock to the whole system, including transformers and generators, is very much less than in the case of a system employing single-core cables (and still more so than in one employing 3-core, 3-phase cables; where a fault in a single cable may short-circuit the whole system), owing to the fact that the outermost cores are very much nearer to the potential of the earth, and that, therefore, only a small portion of the system is short-circuited. The outermost concentric core in each cable therefore acts, as it were, as a "tell-tale," and anticipates the impending failure of the cable.

Another point of considerable importance in connection with the "Hexaphase" system is that, if any one cable fails, it does not prevent the continued functioning of the remaining "subsidiary" or 6-phase systems; nor the functioning, for a short period at least, of the whole power of the superposed 150,000/160,000-volt system. In any case the position is better than with six 1-core cables.

Table I will serve to give an idea of the tremendous possible savings of the "Hexaphase" system.

TABLE I.

Thousands of kW	20	40	80	120	150	225
3-core (50 000 V)	3	5	9	13	20	35
1-core (at 100 000 V) ...	7	7	10	10	10	14
3-ph./6-ph. (at 150,000 V) ...	2	3	5	5	5	7

When it is borne in mind that each mile of cable—for either of the three systems compared—costs, roughly, £2,500, exclusive of laying, it will be realised that on a 30-mile transmission line there is a saving, as between the "Hexaphase" system and the 50,000-volt, 3-phase, system of £1,125,000; and as between the "Hexaphase" system and the single-core system a saving of £375,000, when 150,000 kW are being transmitted—without taking any cognisance of the greatly-reduced initial capital outlay, nor of the increased reliability of transmission of the "Hexaphase" system, to which it is difficult to assign a definite monetary value.

Resonance Conditions on a Long Line.

Table II is worked out upon a formula established by Messrs. Evans and Sels in the American *Electric Journal* (July, 1921), based upon the transmission system being run on no load or light load. Resonance, according to Messrs. Evans and Sels, should occur when:—tan $(2\pi f l \sqrt{L C} = \sqrt{L}/2\pi f L_s \sqrt{C}$.

TABLE II.

Resonance: according to Evans & Sels' Formula.
Receiver Transformer is open-circuited on Primary Switches throughout.

Harmonic.	tan $(2\pi fl\sqrt{LC})$	l miles route length.	$\sqrt{L}/2\pi fL\sqrt{C}$	L_s Inductance of sending end.	L Inductance per mile.	C Capacitance per mile.	System Periodicity.
		(Single cable)		0·08*			
1st.	0·059	30 miles	2·52	(·06+·02)	$0·4\times10^{-3}$	$0·4\times10^{-6}$	25~
3rd.	0·18	,,	0·84	,,	,,	,,	,,
6th.	0·36	,,	0·42	,,	,,	,,	,,
9th.	0·59	,,	0·28	,,	,,	,,	,,
12th.	0·84	,,	0·21	,,	,,	,,	,,
18th.	1·826	,,	0·14	,,	,,	,,	,,
				*Generator = ·06 Inductance	Transformer = ·02 Inductance		
				Revised values taken for L and C.			
		(Single cable)			(Single cable)	(Single cable)	
1st.	·0297	15 miles	3·40	·08	$0·55\times10^{-3}$	$0·3\times10^{-6}$	25~
3rd.	·089	,,	1·13	,,	,,	,,	,,
6th.	·178	,,	·57	,,	,,	,,	,,
9th.	·273	,,	·38	,,	,,	,,	,,
12th.	·368	,,	·28	,,	,,	,,	,,
		(Single cable)		0·10*			
1st.	·0297	15 miles	2·72	(·07+·03)	$0·55\times10^{-3}$	$0·3\times10^{-6}$	25~
3rd.	·089	,,	0·90	,,	,,	,,	,,
6th.	·178	,,	0·45	,,	,,	,,	,,
9th.	·273	,,	0·30	,,	,,	,,	,,
12th.	·368	,,	0·22	,,	,,	,,	,,
				*Generator = ·07 Inductance	Transformer = ·03 Inductance		
		(2 Cables in par'l)			Joint L (2 in par'l)	Joint C (2 in par'l)	
1st.	·014	7·5 miles	1·33	·10	$0·275\times10^{-3}$	$0·6\times10^{-9}$	25~
3rd.	·044	,,	0·44	,,	,,	,,	,,
6th.	·089	,,	0·22	,,	,,	,,	,,
9th.	·133	,,	0·15	,,	,,	,,	,,
12th.	·178	,,	0·11	,,	,,	,,	,,

In all the above take: (Generator Unit = 20,000 K.W. / Transformer Unit = 10,000 K.V.A. (3 Transformers)) Cable = 0·2 sq. in.—3 core Voltage = 30,000 V.

Constants are taken which, for a 10,000-kVA transmission line operating at 30,000 volts with underground cables, give the relative values shown for these two expressions. The figure of 0·08 for the lower and 0.10 for the higher values

TABLE III.

Resonance Conditions for a 10,000-kVA 30,000-volt 0·2 sq. in. 3-core cable 25~ normal)
Receiver short-circuited except where otherwise specified.

——	"l" (miles)	$f = 75$~	$f = 225$~ (9th harmonic)	$f = 375$~ (15th harmonic)
"A" $\left\{\frac{-2\pi f(L_r+L_s)}{\sqrt{\frac{L}{C}}-(2\pi f)^2 L_s L_r \sqrt{\frac{C}{L}}}\right\}$	—	$\alpha = -2·4$	$\alpha = +2·13$	$\alpha = +1·18$
	—	$\alpha' = -0·71$	$\alpha' = +5·52$	$\alpha' = +1·70$
	—	$\alpha'' = -1·70$	$\alpha'' = +2·39$	$\alpha'' = +1·23$
	—	$\alpha''' = -0·8$	$\alpha''' = -3·60$	$\alpha''' = +4·23$
"B" $\{\tan(2\pi fl\sqrt{LC})\}$	70	—	+3·08	—
	60	+0·20	+1·24	+3·57
	45	+0·275	+1·03	+2·27
	30	+0·18	+0·59	+0·97
	15	+0·09	+0·27	+0·49

Resonance occurs when "A" = "B"; both numerically and algebraically.
(α) = including generator inductance (= ·06 H for a 20,000-kW generator).
(α') = excluding generator inductance (*i.e.*, with all generators on the bars when inductance is very small).
(α'') = including generator inductance, but with "short" on h.p. side of receiver.
(α''') = excluding generator inductance, but with "short" on h.p. side of receiver.
Receiver inductance = 0·02 H (same as step-up transformer).
L_r = receiver inductance.
L_s = sending-end inductance.
L = inductance per mile of cable.
C = capacitance per mile of cable.
l = length in miles.

of the inductance at the sending end will sufficiently cover most cases occurring in practice of this magnitude of transmission.

In the case of 3rd, 9th, &c., harmonics, the generator inductance should be omitted. In this case the figures given in the 4th column of the table should be multiplied by four (or by 3.3). In any case where a transformer is working open-circuited on the secondary side, a reactance value from 400 to 600 times greater should be taken than that taken in the table for the transformer.

The author has also worked out the conditions for resonance postulated by Messrs. Evans and Sels when a short-circuit takes place on the low-voltage side of the step-down transformer at the receiving end, and also when it takes place on the high-voltage side of the same transformer (that is to say, at the end of the high-pressure line; the transformer being disconnected). It would seem, from the figures given in Table III that there is no danger of resonance below, or on, the ninth harmonic under 60 to 70 miles (of single cable).

(To be concluded.)

The "A D" Primary Cell.

An interesting primary cell of novel construction has recently been placed on the market by Messrs. Le Carbone, who have had many years of experience in the manufacture of primary cells for Continental administrations, railways, &c., though they are here best known, perhaps, for their carbon brushes, telephone carbons, and other carbons for electrical purposes.

Fig. 1 shows the components of one of the larger types of

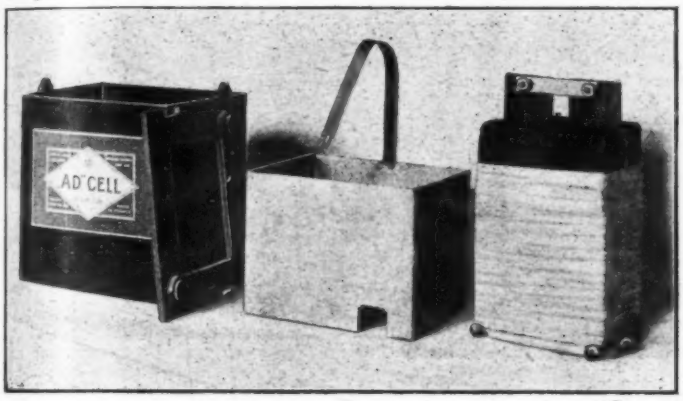


Fig. 1.—Components of Large "A D" Cell.

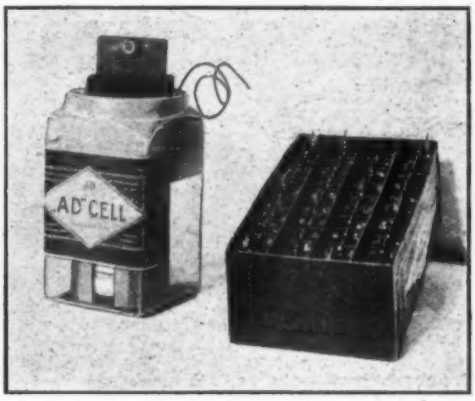


Fig. 2.—"A D" Cell in Glass Jar, and High-pressure "A D" Battery (40 V).

cell, of which the following is a short description. The central carbon plate to which the connecting terminal is fixed is held between extremely porous carbons of special manufacture. The surfaces of the carbons are so prepared that they allow gases to pass through, whilst they remain impervious to liquids. The carbon blocks are surrounded by wrappings of cloth bound in turn with string and rubber bands. The upper surfaces of the carbons must be left well out of the electrolyte, thus allowing them to "breathe" and the depolarising action of the air to operate. The zinc encircles the element, and the cell is excited by an ordinary saturated solution of salammoniac. Fig. 2 shows an "A D" cell in a glass jar, and a 40-volt high-pressure battery for wireless sets.

The fundamental reaction of the cell is as follows:—

$$2\,N\,H_4\,Cl + Zn = Cl_2 + 2\,N\,H_3 + H_2.$$

Putting it in simple language, the hydrogen resulting from the action of the salammoniac on the zinc moves towards the surface of the carbon electrode, which it would rapidly cover, thus polarising the cell and entailing a drop of voltage. The construction of the carbon blocks surrounding the central carbon electrode is such that they absorb oxygen from the air, which, owing to the catalytic action of the porous carbon, combines with the above-mentioned hydrogen, immediately forms water, and depolarises the cell. This rapid depolarisation gives a constant voltage within the correct current discharge range specified for each cell. There are, of course, minor reactions such as the formation of ammonia, which enters the porous carbon and is dissolved in the moisture contained therein.

A further noteworthy feature is the regenerative power of the cell, which is said to result in a very small consumption of salt and zinc, much below the theoretical figures.

The cells cover a complete range—wet, hermetic, and dry—for small or large outputs. Emphasis is laid on the fact that, owing to the absence of any chemical depolarising agent, local actions are eliminated, discharges at constant voltage result, and the ampere-hour capacity is stated to be far ahead of that of any other primary cell of equal dimensions. As compared with manganese-depolariser cells, whether of the wet or dry type, it is claimed that the ampere-hour capacity of the "A D" cell is two or three times as great.

The larger types of cell are suitable for such work as block

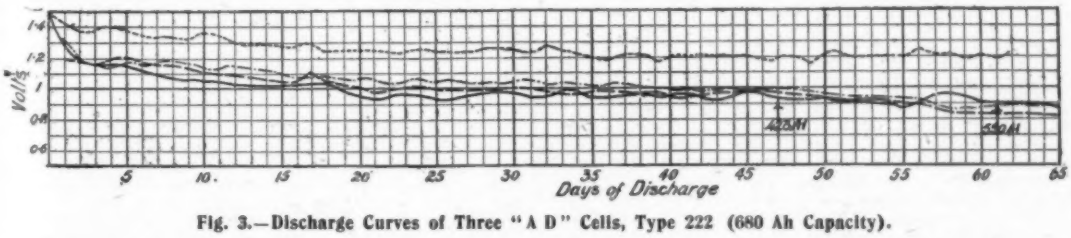


Fig. 3.—Discharge Curves of Three "A D" Cells, Type 222 (680 Ah Capacity).

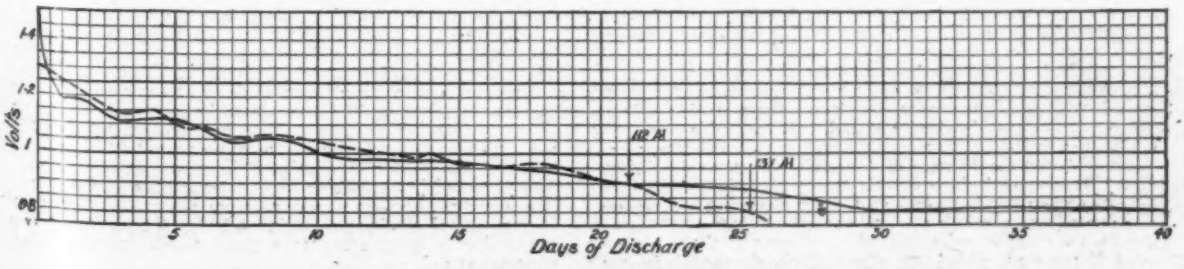


Fig. 4.—Comparative Test of Two Le Carbone Dry Cells on Continuous Discharge.

signalling, signal control, and other railway applications. The "A D" signal cell, for instance, discharges continuously at a rate of 0.25 ampere or even higher for short periods of "occupied" track," and for momentary peaks the rate may reach from 3 to 5 amperes. For heating the filaments of valves in radio sets, for certain heavy-current telephone work, for emergency batteries for lighting purposes, and similar applications, the "A D" batteries have an output of 1 ampere or more.

As an example of the signal-type cell for track-circuit work, we are informed that on a poor track discharging "unoccupied" at 0.18 A and "occupied" at 0.45 A per cell, a battery of four cells connected two-series-two-parallel remained in service from the middle of June to November, 1923, giving an output of 750 Ah per cell. After the zincs and electrolyte had been renewed, the discharge was resumed, and has so far amounted to 450 Ah per cell. There has been practically no maintenance, and the general conditions of the whole battery are said to be excellent.

Cells of the "A D" type have been submitted to the National Physical Laboratory for prolonged tests, which are now in progress. In the meantime we have received from Messrs. Le Carbone a number of discharge curves which have been issued on the authority of the Telephone Department of the French Government; some of these are reproduced herewith.

Fig. 3 relates to three wet cells, each of which was discharged through a resistance of one ohm for eight hours daily, with a rest of 16 hours after each run. The dotted line shows the open-circuit voltage before the beginning of the daily discharge; the other three curves show the voltage at the end of each period of discharge over 62 days—the zincs were renewed on the 69th day, and the test was continued. The electrolyte was refreshed about the 32nd and 54th days. Cells of this size would run a valve.

Fig. 4 represents the continuous discharge of an "A D" cell, type 520, and a manganese-depolariser cell—both dry cells, made by Le Carbone—through a resistance of 5 ohms, down to 0.8 volt. The former measured 6 x 3¼ x 3¼ in., and had a capacity of 170 Ah; the latter measured 7¾ x 4¾ x 3¾ in., and had a capacity of 131 Ah. It will be seen that the "A D" cell reached the limit in 40 days, whilst the ordinary type ran out in 25 days.

Owing to the absence of a chemical depolariser, the cells do not deteriorate when kept in stock.

The extreme simplicity of the "A D" cells, combined with their freedom from perishable constituents, their large ampere-hour capacity, and the high rates at which they can be discharged, should render them suitable for a wide range of uses, of which some have already been indicated above.

Applications of Electricity and Magnetism in Metallurgy.

Professor C. H. Desch in a recent lecture on "The Physicist in Metallurgy," delivered before the Institute of Physics, referred to several interesting metallurgical applications of electricity and magnetism. At the outset he showed that much recent progress in metallurgy had been consequent on the requirements of the electrical industry, instancing such metals and alloys as copper and aluminium of high conductivity, resistance alloys of low conductivity and low temperature co-efficient, transformer irons of high permeability, permanent magnet steels of high coercive force, alloys having a co-efficient of thermal expansion close to that of glass, and tungsten filaments that could be heated to whiteness for long periods without becoming brittle.

The following examples of direct applications of magnetism may be new to many electrical engineers. The susceptibility of a metal or alloy varies with the temperature, and the curve of variation has been used in Japan to study the temperatures of transformation (the critical points) of steels, and hence to throw light on their constitution. Magnetic methods of determining the hardness of heat-treated steels are now becoming common, and an instrument is in use by means of which the quantity of carbon in a furnace bath can be rapidly estimated by casting a slender bar of the metal in an iron mould and successively magnetising and demagnetising it under certain conditions. A magnetic method for detecting transverse cracks in rails, wires or cables is in use in America. Such long objects, having a uniform section, are surrounded by a solenoid which travels along them at a uniform rate. A test instrument, consisting of two small opposed coils connected with a galvanometer, lies inside the solenoid. When the apparatus travels along a sound rail or cable, no galvanometer deflection is produced, but an internal transverse crack disturbs the balance of the coils and causes a deflection. Developments in magnetic theory should prove of considerable value to the metallurgist. The remarkable magnetic Heusler alloys, consisting of copper, aluminium and manganese, were discovered empirically, and so was the non-magnetic 20 per cent. nickel-iron alloy. Curiously enough in low carbon nickel-iron alloy in which the nickel is increased to 78.5 per cent., the permeability in weak fields far exceeds that of pure iron, and the alloy is magnetised nearly to saturation in the earth's field. This steel under the name "Permalloy" is finding application in cable work. On the other hand, Honda, in Japan, was led partly by theoretical considerations to the discovery of his cobalt-steel, containing some 40 per cent. of cobalt, now used for making permanent magnets having an extremely high coercive force. Similar steels are being made in this country.

A highly ingenious application of an electrical method for very sensitive mechanical measurement is that devised in Prof. Desch's own laboratory by Mr. Cecil Handford. The problem was to determine the load required to produce the first slip on crystal planes in a metallic test-piece under tension or compression. The most refined microscopical methods failed to detect the slip until it reached an advanced stage. In Mr. Handford's method a flat polished surface of a test-piece is in contact with a thin sheet of mica against which a brass plate is lightly clamped, the arrangement constituting an electrostatic condenser. When tension is applied to the test piece the surface remains plane so long as the extension is elastic, but plastic slip causes a minute ruffling of the surface and this diminishes the capacity of the tiny condenser. The change is detected by means of a heterodyne arrangement of valves producing an altered note in a telephone receiver and the method is of extreme sensitiveness.

X-ray analysis of metals has already proved of value to the steel manufacturer and its value both as an instrument of research and of measurement is likely very greatly to increase even in the near future. The method, combined with the electronic conception of atomic structure, is already teaching us something about the nature of cohesion and it has helped Dr. A. Griffiths to obtain a silica glass with a cohesive strength far in excess of that found in ordinary practice and approximating to the theoretical limit. It may therefore help us to make metals and alloys of much greater mechanical strength than any known at present. Of the vexed problem of allotropic modifications of iron, the X-ray analysis has given a decisive solution, for it has shown the alpha-space lattice to be present in slowly-cooled steels, so that the increased hardness can only be due to the presence of the carbon atoms, producing distortion of the lattice.

An interesting application in the reverse direction—from metallurgy to electricity—is in the production of large single crystals of metals. These have been made by introducing a nucleus into a molten metal and growing the crystal at a rate just equal to the velocity of crystallisation. The tungsten filaments used in lamps become coarse-grained after a time and when the grains extend over the entire cross-section of the filament, fracture easily occurs. Filaments composed of a single crystal are now being successfully used, thus avoiding all grain boundaries. Such filaments are free from elastic after-working, and therefore are very suitable as galvanometer suspensions.

A recent development in the melting of metals is the use of the high-frequency induction furnace, by means of which a crucible charge of metal can be rapidly melted in a good vacuum, without contamination. This furnace is not only valuable as a laboratory apparatus but is used in several manufacturing operations. Finally, Dr. Desch drew attention to the possibilities of the thermionic valve in metallurgical work, which so far have been little considered.

X-ray Study of Copper-Aluminium Alloys.—In a paper recently read before the Institute of Metals, Messrs. E. R. Jette, G. Phragmen, and A. F. Westgren, Ph.D., described their X-ray studies of the copper-aluminium alloys, the investigation being made by melting together copper and aluminium of the usual electrolytic quality in sand crucibles and a carbon resistance furnace. To lower the oxidation, the meltings were in some cases protected by a layer of soda-glass slag, and all the alloys were examined microscopically, to be certain that they were practically homogeneous and free from inclusions. The copper content was determined in all the alloys, and, whenever especially important, the aluminium content was also established. A series of the alloys, slowly cooled from the liquid state, was investigated by the powder method. The X-ray apparatus (iron anticathode) and the cameras used for taking the powder photograms were described at a recent meeting of the Iron and Steel Institute. The photograms produced show that four different phases appear in the alloys. The $CuAl_2$ phase has tetragonal structure, with an axial ratio of 0.805. The elementary prism is body-centred, and contains four molecules of $CuAl_2$. The phase present in the range 16 to 25 per cent. aluminium has a cubic lattice. In the 16 per cent. alloy the elementary cube contains about 52 atoms, and in the 25 per cent. alloy the corresponding number is only 49. The solutions within the range are thus formed by a *complex substitution*. The curve of the change of density is in closest agreement with that obtained by supposing that three copper atoms in the lattice are replaced by two aluminium atoms. A photogram of a quenched specimen containing 12.5 per cent. aluminium shows lines corresponding to a phase stable only at higher temperatures.

English-Electric Truck-Type Switchgear.

A New Ironclad Product.

THERE is an increasing demand for the ironclad truck-type of "draw-out" switchgear for use, not only in sub-stations and industrial works, but also in generating stations, mainly due to the small space required to accommodate such apparatus and to its extreme accessibility. Such gear is now being produced by the ENGLISH ELECTRIC CO., LTD., and will deal, it is claimed, with short-circuit currents, which may occur on generating plant, up to 20,000 kW. Two sizes of trucks are dealt with: One for 11,000 volts up to 600 amperes, and a smaller size for 6,600 volts. In amperage rating the trucks are available up to a maximum of 1,200 amperes for 3-phase circuits, the larger truck being used for the heavier currents at low voltages.

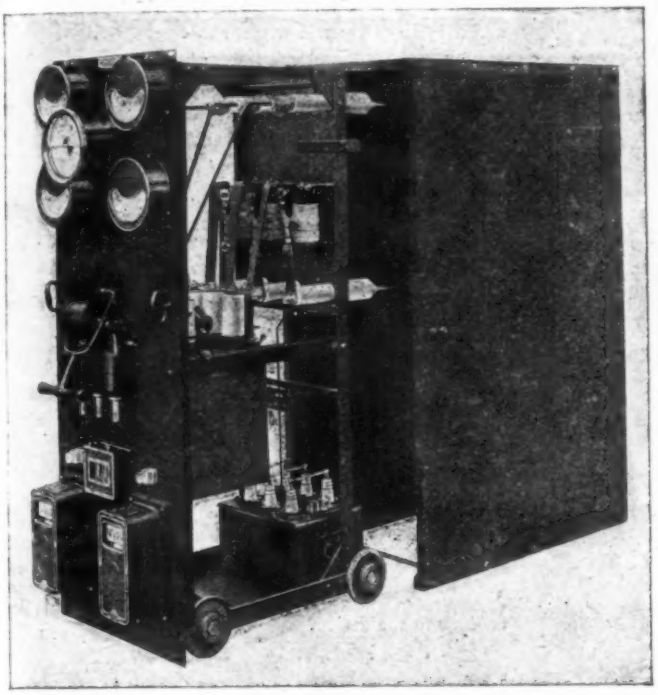


Fig. 1.—"English-Electric" Truck-type Switchgear.

It is scarcely necessary to describe such gear in detail, as the type has by now, no doubt, become familiar. Briefly, however, a fixed cellular portion contains the busbars and cable terminals. A movable truck running on wheels carries the whole of the apparatus for each circuit. When pushed home the truck engages through plug contacts with the busbars and cable connections, and when withdrawn the whole of the apparatus is said to be completely isolated, and the truck can be wheeled away over any ordinary factory floor. Suitable interlocks are provided to prevent the withdrawal or replacement of the truck when the oil switch is in the "on" position, and when the truck is withdrawn automatic shuters close the openings through which the plug contacts pass so as to render accidental contact with the "live" parts impossible.

Switchboards built up of these truck units can be installed with their backs close up to the wall. Special arrangements have been made to allow for connecting cables or trifurcating boxes and for the inspection of busbars and insulators from the front by the removal of semi-permanent partitions. The gangway normally required by the operator at the front of the board gives sufficient space for the withdrawal of the trucks.

No castings are used in the construction of the framework, so that the possibiltiy of breakage in transit, especially for export, is considerably minimised; the interlocks are simple and there is no complicated mechanism to get out of order. Each truck is provided with a hand lock of the "figure" type, in which the numbers stand out on the socket of the lock and engage with similar numbers recessed in the key. This is an advance on the older methods of supplying automatic catches incorporated in the truck handles, or an unsightly padlock to lock the truck in position.

The oil switches are of the "spring-tank" type; each tank is filled to the top with oil to exclude all air and any explosive mixture which is liable to collect. Momentary expansion, or any pressure generated on braking heavy currents, is relieved by suspending the tank on suitable springs.

The clearances laid down in the British standard specification for oil switches are maintained throughout this gear, and the wiring connecting the secondary circuits is run in fibre tubes neatly fixed to the framework. One of the chief features is that up to 600 amps. in either size of truck unit (*i.e.*, for the majority of circuits), all trucks are interchangeable, so that should it be necessary for any truck to be overhauled continuity of supply can be maintained by inserting a spare truck, or one from another circuit not in use at the time. Above 600 amps., trucks of the same voltage and amperage rating are interchangeable.

Another point in this design is that duplicate busbars can be provided, if required, by increasing the height of the framework and, as will be seen from the accompanying illustrations, a considerable number of instruments can be accommodated on the boards, as well as the usual combinations of overload, no-voltage, and leakage trips, &c.

The fronts are attractively finished in black and nickel, and switchboards composed of these units present a pleasing and symmetrical appearance. It is an additional recommendation that they do not require special foundations.

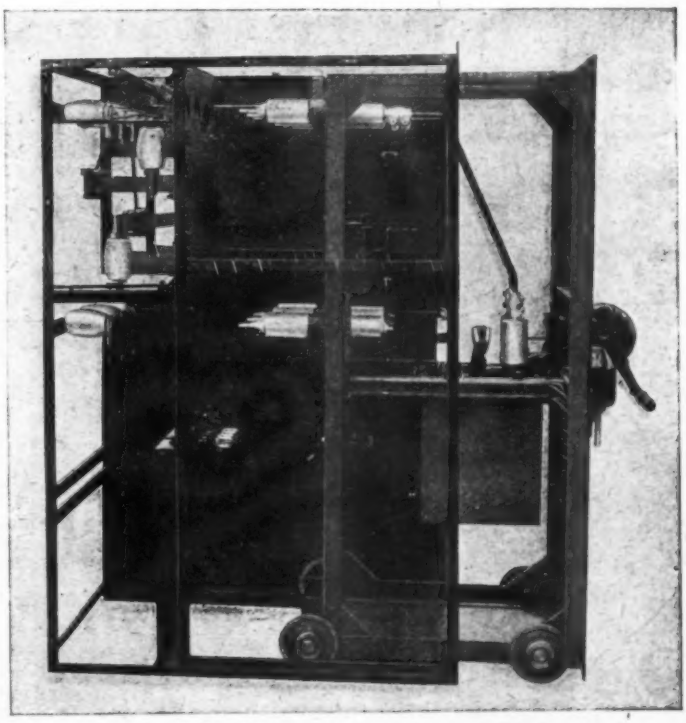


Fig. 2.—"English-Electric" Truck-type Switchgear.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A "Heatrae" Portable Immersion Heater.

The accompanying illustration (fig. 1) depicts a large portable immersion heater made by Electric Fires, Ltd., King Street, Norwich. This is loaded to the equivalent of 9 kW, and consists of four bladed heating elements. These blades are screwed into a steel base plate and a welded-steel domed cover is put on and bolted down to the base plate, as shown in the illustration. The extension stem, consisting of 1-in. steel barrel, is fastened into the domed cover, and the connecting leads are taken up through it into a water-tight screwed coupling at the top. This coupling is arranged with pins on the fixed part and sockets on the removable part. There is a loose cap which can be screwed on to the fixed part of the coupling when the socket portion is removed. This cap protects the pins and keeps the whole device tight. The total length is about 4 ft. There is a steel loop fitted to the top for lifting, the total weight of the appliance being about 50 lb. The blades are protected by steel strip guard, upon which the heater can stand. This type of heater has a very useful application in the warming of large drums or tanks of oil and to prevent certain classes of oil from solidifying in cold weather.

Fig. 1.—9-kW Portable Immersion Heater.

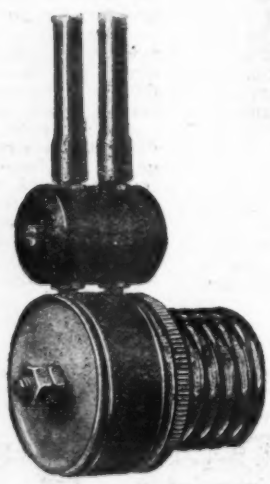


Fig. 2.—Cathode Connection for Coolidge Tubes.

Cathode Connection for Coolidge Tubes.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C.2, have introduced a new cathode connection for Coolidge tubes which has been designed to give greater freedom of movement, and provide a more substantial, safer connection. The device, which is illustrated in fig. 2, is screwed directly on to the cathode end of the tube, and attached to the screw connection is a swivel head which allows free movement in a complete circle. The cathode leads are attached to a two-pin plug, and are separated and protected from strain by two "Sistoflex" tubes attached firmly to the plug. The plug is of ample dimensions, and while it is easily inserted or removed, there is no risk of accidental detachment. When the pins are inserted in the swivel head, the cathode leads may be led away in any direction at right angles to the axis of the tube, and all necessity for looping the high-pressure wires is therefore avoided. An alternative connection for the high-pressure leads can be made by means of the two lock nuts seen in the illustration.

Strip-Grid Resistances.

A type of resistance which is claimed to have many advantages over existing patterns has been put on the market by the Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W.8. The resistance element of each grid consists of a length of strip with holes punched at equal intervals. This is threaded over two or more insulated steel supporting rods with insulating washers separating the layers, the whole being clamped tightly together. The element is carried between two substantial steel bars, which are provided with the necessary fixing holes. In addition to the insulating washers there is a metal washer adjacent to the strip. This reinforces the conductivity of the strip at the point where it has been diminished by the loss of metal due to the hole punched in it. It will be seen from the illustration (fig. 3) that a considerable number of tappings can be added to any strip-grid without interrupting the continuity of the strip. Connectors and tappings (when required) consist of suitably slotted copper straps inserted at one end of the grid and supported on an additional insulated bar, which is provided to take the weight or strain of connections. As the holes in the strip are at equal intervals, a grid of any length can be constructed merely by the provision of larger steel bars to carry the unit. Similarly, the insulated supporting rods can be increased to any reasonable length so that it is possible, within limits, to construct a strip-grid of any length and breadth. For convenience, strip-grids have been standardised in lengths of 12, 16 and 20 in., but these lengths can be increased at will in multiples of 4 in. The resistance material used has a negligible temperature coefficient. The possibility of expansion and buckling due to heating has been taken into account in the design.

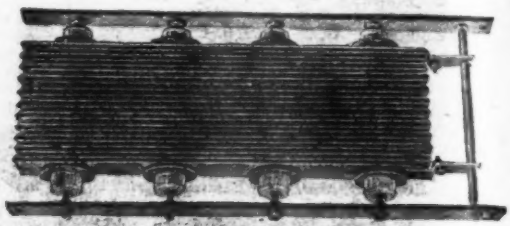


Fig. 3.—A Strip-Grid Resistance.

The "Universal" Table Stove.

The "Universal" table stove (fig. 4) sold by Messrs. L. G. Hawkins & Co., Ltd., 116, Charing Cross Road, W.C.2, is a handsomely-finished appliance with many uses. The heating portion is provided with a three-heat snap switch, and the element is arranged to give equal distribution of heat. There are three pans of seamless aluminium with rounded corners, *viz.*, a 2-in. deep pan, another similar pan to fit inside it to the depth of about 1 in., and a shallow pan which can be used as a reflector, deflector, cooking cover, or frying pan. There are also a nickelled cooking cover which fits over any of these pans, a grid for boiling and roasting, and an egg poacher.

Fig. 4.—The "Universal" Table Stove.

Electro-Harmonic Concert.—The last smoking concert of the Electro-Harmonic Society for the season will be held in the Caxton Hall, Westminster, to-night, Friday, March 14th, at 8 o'clock. Mr. G. L. Addenbrooke will preside, and the artistes will be:—Mr. Barrington Hooper, tenor; Mr. Tom Kinniburgh, bass; Mr. Philip Cathie, violin; Mr. Selwyn Driver, songs at the piano; Mr. Kit Keen, humorist; Mr. Robert Pitt and Mr. Langton Marks, in their famous duets up to date; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

The Lighting of Trains, Tramcars, and Omnibuses.

A discussion on the above subject was opened by Messrs. J. F. Caine and E. A. Marx (Junr.) at the meeting of the Illuminating Engineering Society on February 19th, Mr. L. Gaster presiding. On several occasions in the past the Society has dealt with railway lighting, and at the meeting referred to attention was devoted chiefly to the lighting of coaches and compartments. There can be no question that in railway carriages, as well as in tramcars and omnibuses, matters have improved very greatly during recent years—largely due to the widespread use of electricity, which lends itself particularly well to this field. There are, however, several special problems, such as the effects of vibration (now solved fairly satisfactorily by modern lamp design) and the results of voltage variation, which is apparently inevitable during periods of acceleration. In view of these circumstances, the value of five foot-candles suggested by the authors is probably not excessive, though the limited headroom makes the maintenance of an even high illumination no easy matter, and there are probably at present few vehicles lighted by any means where this value of illumination is provided. The method of using trough-reflectors equipped with opal glass, which the authors described, seems promising. Whilst the authors' suggestion that all lighting problems on a railway or system of tramcars and 'buses should be supervised by a single expert is sound, it must also be realised that in most cases co-operation between several experts is needed. Lighting has become an important feature in modern transport, and it is satisfactory to note that a number of railway and tramway engineers took part in this discussion.

In their introductory remarks the authors referred to the widespread use of electricity in lighting all kinds of vehicles. A general problem in 'buses and tramcars, and to some extent in railway carriages, was the effect of vibration. Lamps with specially-designed filaments had been made to withstand shock, of which the spiralised filament mounted in a "castellated" form was one of the most satisfactory. Another special problem in this case was the variation in pressure. There was at present no standard voltage for lighting in transport. In 'buses 20-30 V was usual. In the case of electric trains and tramcars four or five lamps might be run in series at the track voltage of 500 or 600. Abroad a d.c. voltage of 1,500 was not uncommon. If such a pressure were adopted in electrification schemes in this country it would present the lighting expert with new problems. A marked voltage drop might occur when trains were accelerating. On the Italian railways 35 per cent. was allowed for. Such a fall would lead to an 86 per cent. diminution in candle power.

Carriage lighting fell into two types according as one was dealing with saloons or compartments. In either case the problem resolved itself into avoidance of glare and proper distribution of light. Rows of bare lamps, in the direct range of vision of standing passengers, were distinctly trying. Limited headroom involved the use of special fittings. So far no standard type had been adopted for carriage lighting, but the authors mentioned, with approval, a new system of trough reflectors each carrying two 20-W lamps and fitted with cylindrical opal glass to diffuse the light. Twenty-three such fittings allotted to a coach and consuming in all 920 watts gave an even illumination of five foot-candles. The authors suggested that in modern carriage lighting a value of this order should be aimed at.

In drivers' compartments there should be no light, except, if necessary, concealed illumination (0.5 ft. c.) of the dials of instruments. Interior lighting, unless very subdued, interfered with the vision of drivers looking through the glass window into the surrounding darkness. The same remark applied to signal boxes. In all forms of coaches a ceiling of a dull white or light fawn colour was desirable in order to diffuse the light.

Turning to railway lighting in general, the authors commented upon the great variation in the amount of illumination allotted to platforms. Readings from 0.04 to 4.7 ft. candles had been recorded. It was suggested that the minimum for termini should be two foot-candles, for important junctions 1 foot-candle, while even wayside stations required adequate platform lighting (if necessary only turned on full when trains were due), instead of the customary "beacon lighting."

There were various other places where special lighting was necessary, *e.g.*, at barriers (3 foot-candles), at windows of booking offices (5 foot-candles), and for Customs examination (5 foot-candles). Something should also be done to render names of stations clearly distinguishable by night by the use of special concealed lighting and the adoption of distinctive colour patterns. In the lighting of goods yards, &c., deep-skirted reflectors completely concealing the filament from view should be adopted. Some of the chief points mentioned in the paper were summarised as follows:—(1) The need for more general use of scientifically-designed lighting units in vehicles to ensure avoidance of glare, better illumination and more perfect distribution. (2) No light in drivers' compartments, and only subdued light in places where workers had to watch dark spaces outside. (3) Agreement on standards for the lighting of railway platforms. It was also urged as desirable that the complete lighting of a railway or a system of tramcars and 'buses should be under the control of one expert, and that whenever extensions and improvements were made plans for the lighting should be considered at an early stage, as it was only in such circumstances that the best results could be economically obtained.

An interesting discussion was opened by Mr. A. Cunnington, of the London & South-Western section of the Southern Railway, and engineers associated with other railway and tramway undertakings took part.

The National Council of Technical Associations.

The following communication has been received from the newly-formed National Council above-named:—

It is now becoming generally recognised that it is necessary for technical engineers, chemists, scientific workers, and other allied professional men to be organised if their interests are to be protected and promoted and if they are to make heard collectively an effective voice in the furthering of the welfare of industry.

The last few years have seen a remarkable growth of societies for these purposes, but whilst many of them which have arisen in such industries as electricity supply, engineering, and chemical manufacture, &c., have been partially successful in advancing the economic welfare of their members, they have found by experience that owing to their isolation from one another, and their comparatively small numerical strength, they have been unable to exercise that influence or acquire that prestige to which the professional standing of their members entitles them.

When questions of general policy affecting industry have been made the subject of legislative enactment, the technical staffs have rarely been consulted, and even when they were in a position—by virtue of their special knowledge—to make a contribution of service to industry or the State, the opportunity has not been open to them. Though admittedly it is upon them that the development of industry largely depends, their collective voice has practically been ignored hitherto when industrial questions have been under consideration, or when the conditions under which their work is carried on have been settled.

This has been due to the fact that they have been insufficiently organised, and that—unlike other workers in industry—they have had little opportunity of co-ordinating their efforts, or of acting in unison on those larger issues which are of common interest to them all.

The National Council of Technical Staff Associations has recently been formed with a view to remedying this deficiency. Its main object is to link together, so far as is possible, the activities of the various protective organisations of technicians in industry, so as to enable them to co-operate more effectively.

Its inauguration was the outcome of a joint conference of delegates representing several societies of technical engineers and chemists, which was held in December, 1923, and although at present it is composed of three constituent bodies only, *viz.*, the Electrical Power Engineers' Association, the Society of Technical Engineers, and the Engineer Surveyors' Association, it hopes shortly to enlist the active support of other similar organisations, such as the National Union of Scientific Workers, the British Association of Chemists, &c.

The regulations which have been drawn up are wide enough to allow of the Council taking an effective part as an advisory body in co-ordinating the work and policy of the constituent societies, whilst maintaining adequate safeguards to prevent encroachments on their autonomy.

It is proposed, as a beginning, that the energies of the Council should be concentrated on those matters upon which agreement can be secured, and also on propaganda work, with a view to impressing upon technical engineers, &c., the desirability of their being organised on a professional basis. Meetings are shortly to be arranged in the large industrial centres. The first of these is to be at the Milton Hall, in Manchester, on March 28th, and it is expected that several prominent men, who are known to be interested in the organisation of professional staffs, will address the meeting.

The Council looks to all who have at heart the welfare of technical engineers, chemists, and other scientific workers, to support the movement. Joint Secretaries have been appointed, whose offices are at 23, King Street West, Manchester, and 102, Belgrave Road, London, S.W.1.

Legal.

British Thomson-Houston Co., Ltd., v. Commercial Electric Co., Ltd., and Crowther & Osborn, Ltd.

Two applications raising questions of the utmost importance to the electric lamp industry were made to Mr. Justice Tomlin in the Chancery Division on March 7th by Sir Duncan Kerly, K.C. He asked his Lordship to postpone the hearing of two actions by the British Thomson-Houston Co., Ltd., against the Commercial Electric Co., Ltd., and Crowther & Osborn, Ltd. With regard to the first, he said that it was an action for the alleged infringement of a patent of 1909 in respect of tungsten filaments for lamps. The same plaintiffs had succeeded in an action before Mr. Justice Russell against the British Insulated & Helsby Cables, Ltd., in respect of the same patent; and they had also succeeded in an action in the Scottish Courts. An appeal was now pending in the Helsby case, and nobody who was acquainted with the enormous interests involved could doubt that both cases would be taken to the House of Lords. In these circumstances the plaintiffs, said counsel, had issued an enormous number of writs against retailers and lampmakers who had bought wire which constituted the filament in question, and after the trial before Mr. Justice Russell they set them all down for trial, including the two which were the subject of his applications.

He submitted, however, that it would be an outrageous waste of time if all these should be tried over and over again when the whole thing had been fought out so recently in the Helsby case, and he was applying that the two cases should be postponed until after the Helsby appeal had been dealt with. He understood that if the plaintiffs succeeded, the damages to be collected would be many hundreds of thousands of pounds.

There was another element in the present case, said Sir Duncan. In all these subsequent actions the plaintiffs had thought fit to sue not only the company but the directors, and he suggested that this was an attempt to use a patent for the purpose of oppression, and that they were bringing all these proceedings, whether they had got a good patent or not, to ruin the trade of their opponents by suing the manufacturers, the lampmakers, and the customers. That, he submitted, was a use of a patent which no Court would encourage or allow. Another feature in the first case was that the company only used Helsby wire. In the Helsby case the plaintiffs obtained an injunction, but it was stayed because the judge took the view that it would not be right that the Helsby business of wire-making should be ruined by having their trade stopped while the matter was the subject of appeal. The Helsby Company paid into Court the sum of £10,000, which was still in Court, and if damages were recovered the plaintiffs would get from the Helsby Company damages on the footing that they had been licensees. At any rate, they would get their full damages from the Helsby Company, and that meant that they ought not to get damages from the present defendants because they were only using Helsby wire. The Helsby Company was at present going on with its business, but it would not be able to do so if its customers were sued. The implication was that if the company was to go on with its business its wire should continue to be used in the ordinary commercial way, and not make and kept in the warehouses. He said he was willing to give an undertaking pending the House of Lords' appeal not to use any but Helsby wire.

Sir Arthur Colefax, K.C., who appeared for the British Thomson-Houston Co., Ltd., submitted that there was no reason why the cases should be postponed. With regard to Sir Duncan's statement that they were in many cases suing directors, he said the kind of thing they were met with was this: A company had one director who owned all the shares issued by the company, and had an over-riding debenture. Very often the defendants were simply dealers in infringing lamps. The undertaking offered was of no use at all, as the defendants could go on infringing the patent until the House of Lords' appeal had been decided, and doing serious damage to the plaintiffs' trade. It was not correct to say that the damages that might be obtained in the Helsby case franked the filament. The real question was this: The Court had decided that the patent was valid, and that it had been infringed. There were a number of companies with little or no substance in them that were infringing that patent; in fact, infringement was going on more than ever, and the plaintiffs wanted to stop it.

His Lordship: Do I understand that there are a large number of other cases relating to the same patent both in my list and the lists of other judges of the Chancery Division?

Sir Duncan said there were nine in his Lordship's list, and he thought there were 20 in Mr. Justice Romer's list. He thought there were 60 or 70 altogether.

Sir Arthur Colefax said that in one of these cases the company had written consenting to judgment, but there was a director who did not consent, and the issued shares of the company amounted to a few pounds.

His Lordship said he could see that there were some very nice questions being raised with reference to directors, but if there was to be a general stay of these actions pending the Helsby appeal, there ought to be some uniformity of practice, and he would have to consult his brother judges.

Sir Arthur Colefax said that if the cases were postponed, these directors would simply form new companies to carry on.

Sir Duncan Kerly said the object appeared to be to prevent the trade from touching any alleged infringing articles. The Commercial Electric Co. was not one with any debentures. It had £15,000 unencumbered capital. In the case of one of the defendants, the writ was issued before the war.

Sir Arthur Colefax said that the delay in that case was due to the fact that neither party was anxious to have it tried during the war.

Sir Duncan then made a similar application in the case of Crowther & Osborn, Ltd. The company was in voluntary liquidation, he said, and a receiver was in possession, but no business was being done. The directors had also been sued. He (counsel) was prepared to offer not to dispose of any of the company's assets including any of the alleged infringing articles.

Sir Arthur Colefax said the position here was that the company was, he was instructed, merely a cloak for the directors.

His Lordship said with regard to both cases that he would give counsel a few days to consider whether they could arrange anything between themselves, and in the meantime, upon the general question, he would consult with his brother judges and let counsel know the result.

British Thomson-Houston Co., Ltd., v. D. Rose & Co., Ltd.

Mr. Justice Romer, in the Chancery Division on Friday last, granted an injunction to plaintiffs restraining defendants, of Osborn Street, E., from infringing their patent relating to improvements in incandescent electric lamps, and ordered the delivery up of any infringing articles, and an inquiry as to damages.

The action was at first defended, but the defendants did not now appear.

Mr. J. Hunter Gray, K.C., for the plaintiffs, said the patent related to the gasfilled lamp, and it had been held to be valid by the House of Lords. The plaintiffs alleged that the defendants sold twelve 240-volt, 100-watt gasfilled lamps which infringed the patent, but they denied infringement, and only admitted the sale of six.

British Thomson-Houston Co., Ltd., v. The Hendon Electric Lamp Co.

In the Chancery Division, before Mr. Justice Eve, on March 7th, Mr. Trevor Watson moved for an injunction restraining the defendants from infringing a patent of the plaintiff company.

Mr. Courtney Terrell, for the defendants, said that the evidence on his side showed that the lamps bought and sold by them were obtained from the Stella Electric Co., who manufactured them from tungsten wire made by the British Insulated & Helsby Cables, Ltd.

Mr. Trevor Watson said that it was suggested in this case that no injunction should be granted because of the stay of the injunction in the case against the Helsby Co., but that did not cover this case. It was in respect of the manufacture of tungsten wire that proceedings were taken against the Helsby Co., and the plaintiffs were entitled to damages in respect of the whole article if their patent for the manufacture of tungsten wire was used in the manufacture of an article of which it formed a necessary component part. The damages recovered in respect of the manufacture of the wire by the Helsby Co. did not cover the whole of the damage which the plaintiffs suffered by the combined action of the Helsby Co. and the present defendants, because a very large proportion of the damage arose from the sale of the lamps which competed with the plaintiff company's business. Unless some order were made against the present defendants the sale of these lamps would go on until the appeal in the Helsby case was decided, and additional damage would be done to the plaintiffs. If an injunction were not granted in the present case, it should be withheld only on the condition that a sum was paid into Court against future infringement.

His Lordship said if Mr. Justice Russell had dismissed the action against the Helsby Co., instead of granting an injunction, the plaintiffs could not then have got an injunction against anybody for selling lamps containing tungsten wire. Mr. Justice Russell granted the injunction, but on the payment of a certain sum into Court, he suspended the operation of it until the Court of Appeal had considered the matter.

Mr. Courtney Terrell said that the patent was nothing more than the manufacture of tungsten wire; it did not go to lamps. It was not an additional infringement because the wire had been put in a lamp.

Mr. Watson said the plaintiffs had no protection up to the time the appeal was decided.

Mr. Terrell offered an undertaking that the defendants would not deal in lamps containing wire other than that manufactured by the Helsby Co., and would keep an account of all lamps which were sold containing that wire in the future.

His Lordship said there was a difficulty created by the suspension of the injunction, and, on the undertaking offered by Mr. Terrell, he directed the motion to stand till the trial of the action, with liberty to bring it on at 48 hours' notice after the case of the Helsby Co. had been disposed of on appeal.

British Thomson-Houston Co., Ltd., v. North Electrical Co.

In the Chancery Division, on March 7th, Mr. Justice Eve heard a motion by the plaintiffs asking for an injunction

to restrain alleged infringement by defendants of a patent, the validity of which, counsel said, Mr. Justice Russell had upheld recently.

Mr. TREVOR WATSON, for the plaintiffs, said he understood that Mr. Terrell, on behalf of the defendants, was willing to give some form of undertaking until the trial, but he did not know how far he was prepared to go.

Mr. COURTNEY TERRELL said that his instructions were to undertake to keep an account.

Mr. WATSON said that this would not satisfy plaintiffs, and his Lordship granted an injunction as requested until judgment or further order.

Whittle v. W. J. Parrett, Ltd.

A CLAIM for damages for libel was heard by the Lord Chief Justice (Lord Hewart) at the Kent Assizes held recently at Maidstone. The plaintiff was Mr. Alfred Thomas Whittle, formerly trading as the Kent Coast Electrical Co. at 85, High Street, Broadstairs, and the defendants were Messrs. W. J. Parrett, Ltd., proprietors of the *Isle of Thanet Gazette*, Margate.

Mr. Thorn Drury, K.C., and Mr. Malcolm Hilbury appeared for the plaintiff, and Mr. J. D. Cassels, K.C., M.P. (with him Mr. A. E. Woodgate) for the defendants.

Mr. THORN DRURY said the libel was contained in a report, which appeared in the *Isle of Thanet Gazette*, of the statutory meeting of the creditors and shareholders of the Modern Electrical Supply Co., Ltd. (in liquidation), held at Carey Street, Lincoln's Inn, W.C., in March of last year. That report, in giving particulars of the company's history, set forth that it was formed in August, 1921, to carry on business in London, and that in December, 1921, it purchased a business then being carried on at 85, High Street, Broadstairs, under the style of the Kent Coast Electrical Co. Almost immediately afterwards the plaintiff, who had advanced very considerable sums to the Modern Co., thought that, as he was living at Broadstairs, it would be to his advantage to take the business on his own account. Consequently on January 13th, 1922, the Broadstairs business was bought from the company by the plaintiff for the same sum (£250) as had been paid for it by the company. At that time the plaintiff was the principal shareholder, manager and governing director for life of the Modern Co., and on March 20th, 1922, debenture bonds for £5,000 were issued to him as security for his advances to the company. The affairs of the Modern Co. did not prosper, owing to the fact that it had produced large quantities of wireless receiving sets, and that owing to the extraordinary delay on the part of the authorities in issuing licences the whole of the company's capital was locked up, and it did not make the profit it would have made. On December 6th, 1922, a receiver was appointed by the plaintiff as holder of the debentures; that was followed by a resolution for a voluntary winding-up, and on January 16th, 1923, a compulsory order was made by the Court. The statutory meetings of the creditors and shareholders were held in London on March 28th, 1923, and a report of those meetings appeared in the defendants' paper, bearing a sub-heading "Failure of a Broadstairs Firm." Immediately following the publication of that report the plaintiff's troubles began, and in August, 1923, he sold the business to a man in his service for £2,500, but no part of the purchase money was payable until June, 1924. Counsel suggested that this was an undefended action, and it was a question of the amount of damages to be awarded. The defendants' answer was that it was not defamatory, and that it was a matter of fair report and fair comment. There was no question that this report was intended to read that it was the plaintiff's firm that had failed.

The PLAINTIFF gave evidence bearing out his counsel's statement, and was cross-examined at some length by Mr. Cassels.

In reply to his LORDSHIP, Mr. Thorn Drury said that if the second headline "Failure of a Broadstairs Firm" had not been added to the report he would have had no cause for complaint.

Without calling upon Mr. Cassels to address the Court for the defendants, his LORDSHIP summed up the case. He said it had been made clear in the course of the proceedings that nothing was erroneous in the article which was printed in the defendants' journal, except the second headline, "Failure of a Broadstairs Firm," and with regard to that headline the plaintiff said two things: (1) that it was untrue; (2) that it referred to him in a defamatory way. There was no doubt whatever that the headline "Failure of a Broadstairs Firm" was incorrect. It was not a Broadstairs firm which had failed. It was the Modern Electrical Co., who had once purchased the business at High Street, Broadstairs, which had been re-sold to the plaintiff as an individual before the meeting took place or the report appeared. He thought that a jury would be likely to come to the conclusion that the second headline had reference to the plaintiff, and that the plaintiff would be entitled to some damages. That being so, what were the appropriate damages? Was it possible that after the publication of this matter the business carried on at 85, High Street, Broadstairs, fell off? He doubted very much that it fell off because of the publication of this matter. A jury hearing the facts in the present case would have to ask themselves: What would be an appropriate sum to pay to the plaintiff for this defamation? The jury would probably come to the conclusion —at any rate he did so—that one farthing damages should be awarded. That would be the order of the Court, and he would further order that each side must pay its own costs.

Parliamentary.

[By Our Special Parliamentary Reporter.]

Electro-Culture.—On February 27th, Mr. BUXTON, the Minister of Agriculture, informed Mr. WRIGHT that a Committee to advise the Ministry with regard to electro-culture was set up in 1918, and that experiments devised by that Committee had been in progress since that date. Grants amounting in all to £8,000 had been paid by the Ministry in aid of the work. The experiments had shown that certain ypes of electrical discharge had a very marked influence on the development of plant growth, but a great deal had yet to be learned of the best methods and periods of application.

Empire Wireless.—On March 3rd, Sir H. BRITTAIN asked the PRIME MINISTER whether, following the report of the Wireless Committee, whatever decision might be come to by the Government, he would give an assurance to the House that the Empire wireless chain might be put into operation with the shortest possible delay.

Mr. RAMSAY MACDONALD replied that it was precisely in order that the Empire wireless chain might be put into operation with the least possible delay that the Government had acted as it had done. An early opportunity would be taken of placing before the House the action which it was proposed to take on the report of the Committee.

Wireless Licences.—On March 4th, Mr. HARTSHORN informed Sir F. WISE that on January 31st about 636,000 wireless receiving licences were in force; figures for February were not yet available. The total amount actually paid to the British Broadcasting Company by the Post Office up to date was £71,450; but subject to Parliamentary sanction, and to the company's obligation to return any ultimate surplus, as provided in the last agreement with the Post Office, the total amount which the company would be entitled to receive in respect of the fees on these licences would be about £348,000.

London & North-Eastern Railway Bill.—On March 5th, when this measure was brought up for second reading in the House of Commons, considerable opposition was forthcoming, particularly from North London members. Mr. R. MORRISON, the Labour member for North Tottenham, moved the rejection of the Bill, on the ground that by a clause in a private Bill of 1902 the company was enabled to hold up the construction of a tube railway north of Finsbury Park, thus depriving a population of 500,000 of the necessary travelling facilities.

Lord EDNAM, the Unionist member for Hornsey, in seconding the motion, said it was scandalous that such conditions should exist as existed in the area north of London served by the company. That a railway company should have such a monopoly was wrong. The London & North-Eastern Railway Co. could not possibly cope with the travelling requirements of so vast an area. Lord Ashfield had said that had it not been for the clause in the Act of 1902, which stood in the way, the tubes from Finsbury Park and Highgate would have been extended years ago. He hoped the company would consent in committee to repeal the clause in the Act of 1902.

Sir E. HUME-WILLIAMS, speaking for the company, said that the clause in the Act of 1902 was a fair bargain between the two railway companies concerned at the time. The only two companies involved by the clause were the Great Northern and the Metropolitan Railways. There was nothing in the clause to prevent the construction of a tube railway north of Finsbury Park Station by anybody except the Metropolitan Railway Co., and any proposal for the construction of such a tube would receive the consideration of the directors of the London & North-Eastern Railway. In the present Bill there were three clauses relating to the widening and alteration of the company's railway between Liverpool Street and Stratford, in Stepney, and between Fenchurch and Stratford, at a cost of £1,500,000. With regard to the electrification of the line, a rough estimate of the cost was £5,000,000, and he was authorised to say that the company would be prepared within a space of time either to take immediate steps to put into operation the electrification of the line, or to abrogate the clause to which exception was taken.

Mr. GOSLING, the Minister of Transport, said that the Bill, as a whole, was loaded with all kinds of work—not in London alone—and the Ministry was anxious that it should be given a second reading, in order that the work should not be delayed.

After further debate, Col. M. WILSON, a director of the promoting company, said that if the Bill received a second reading and the objection was not pressed the company was prepared to undertake to proceed with all due expedition to a decision on the proposals which it had under consideration to equip electrically a railway at Finsbury Park and northwards, and that, if it should come to the conclusion that it was unable to proceed with this, the company would waive any provision under which its consent was necessary for the construction of a railway north of Finsbury Park.

The Bill was read a second time.

The Gretna Factory.—On March 4th, Mr. Clarke asked the Chancellor of the Exchequer if it was the intention of the Government to allow the factory at Gretna to be put up to auction, as proposed by the Disposal and Liquidation Commission, in view of a Government commission having previously recommended that the Gretna factory should be retained; and was he aware that if the power house was scrapped or disposed of the houses and other buildings would be deprived of electric light and require to resort to oil.

Mr. W. Graham, Financial Secretary to the Treasury, said that he regretted that he was unable at present to add anything to the answers that he had already given on this subject, but in response to representations made to him he was making further inquiries in the matter. He would add that the power house was designed to supply power and light to this large factory as a whole, and its retention for the sole purpose of supplying light to the tenants of the houses would obviously be impracticable. It was hoped that at the auction to be held in June next certain portions of the factory still equipped with fixed plant, &c., suitable for ordinary purposes would attract buyers. In those circumstances, a decision as to the disposal of the power house necessarily had to be postponed.

Electricity Commissioners.—On March 5th, Mr. H. Morrison asked the Minister of Transport whether his department or the Electricity Commissioners were responsible for the statements which appeared in the Press towards the end of the previous week to the effect that a new Draft Order of the Electricity Commissioners for a London and Home Counties Joint Authority was soon to be published, and that this, together with the four company Bills now receiving attention in the House of Lords would, in due course, lead to falls in the cost of electricity; and whether, in considering the Draft Order, the Commissioners were having regard to the desirability, from the point of view of the domestic and industrial consumer, of the public ownership of the electricity supply industry.

Mr. H. Gosling said the only information given to the Press during the past week was that it was hoped to publish the new Draft Order for London in the course of the next two or three weeks. With regard to the second part of the question, the new Draft Order would provide for the establishment of a Joint Electricity Authority and for the control of the generation of electricity in the London and Home Counties District in the public interest.

Post Office Wireless Stations.—On March 6th, Mr. Hartshorn stated that the revenue and expenditure (including interest, depreciation and all overhead charges) in respect of the Post Office wireless stations for the nine months ended December 31st, 1923, were as follows:—Cairo: revenue, £6,666; expenditure, £33,253. Leafield: revenue, £30,389; expenditure, £32,940. Northolt: revenue, £6,557; expenditure, £7,427. Stonehaven: revenue, £4,399; expenditure, £11,389.

Trade Facilities Bill.—This Bill was read a second time on March 5th, by 297 votes to 43, a division being challenged by some Socialist members from the Clyde.

Published Specifications.

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

27,701. "Means for the production or reproduction of sound or like vibration." S. G. Brown. October 12th, 1922. (Cognate applications, 29,804/22 and 5,218/23). (211,183.)

28,235. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). October 17th, 1922. (211,189.)

30,468. "Means for generating electric oscillations." Ges. für Drahtlose Telegraphie and O. von Bronk. February 14th, 1922. (193,379.)

30,640. "Interlocked safety devices for preventing the opening movement of the enclosing parts of electric switchgear." J. A. Hirst and P. S. Brook. November 9th, 1922. (Addition to 121,999.) (211,197.)

30,902. "Wireless installations on vehicles, such as automobiles." N. H. Clough. November 13th, 1922. (211,201.)

31,111. "Device for preventing the formation of, or for extinguishing arcs or sparks at the contacts of electric switches." J. von Clossmann and H. Halberstadt. November 14th, 1922. (211,212.)

31,118. "Electron discharge devices and methods of operating same." British Thomson-Houston Co., Ltd. November 15th, 1921. (189,125.)

31,119. "Metallic resistances." British Thomson-Houston Co., Ltd., and N. Laycock. November 14th, 1922. (211,213.)

31,120. "Ignition systems for internal-combustion engines." British Thomson-Houston Co., Ltd., E. G. Parrott, and A. P. Young. November 14th, 1922. (211,214.)

31,214. "Vacuum tubes." E. Y. Robinson. November 15th, 1922. (211,221.)

31,251. "Oil-immersed electric switchgear." H. Trencham and British Thomson-Houston Co., Ltd. November 15th, 1922. (211,222.)

31,264. "Apparatus for radiology." F. Holweck. November 15th, 1921. (189,137.)

31,486. "Telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. November 17th, 1922. (211,229.)

31,487. "Telephone exchanges." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. November 17th, 1922. (211,230.)

31,488. "Telephone exchanges." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. November 17th, 1922. (Cognate application, 31,490/22.) (211,231.)

31,489. "Telephone exchange systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. November 17th, 1922. (211,232.)

31,792. "Electrically-operated fluid-flow meters." E. H. Freeman. November 21st, 1922. (211,237.)

31,869. "Electric plugs of the telephone type." Pacent Electric Co., Inc. December 5th, 1921. (189,775.)

32,373. "Galvanic batteries or electric accumulators." T. C. Rutter. November 27th, 1922. (211,255.)

32,991. "Methods for the maintenance of constant potential difference or constant currents in electrical circuits." General Electric Co., Ltd., and J. W. Ryde. December 2nd, 1922. (211,268.)

33,055. "Electric light switches." I. Gluckstein. December 4th, 1922. (211,270.)

33,804. "Electrically-controlled means for starting up internal-combustion engines." E. T. Fisk. December 11th, 1922. (211,279.)

34,032. "Rotors for dynamo-electric machinery." G. A. Juhlin, J. A. Kuyser, T. H. Charlton, K. Baumann, and Metropolitan-Vickers Electrical Co., Ltd. December 13th, 1922. (211,284.)

1923.

248. "Magnetic modulators for high-frequency currents." British Thomson-Houston Co., Ltd. January 12th, 1922. (191,723.)

457. "Magnetic modulators for high-frequency currents." British Thomson-Houston Co., Ltd. January 12th, 1922. (191,724.)

2,046. "Means for coupling electric starting motors with explosion engines." G. Harrison (Luma-Werke Akt.-Ges.). January 23rd, 1923. (211,318.)

2,058. "Wireless receiving apparatus." British Thomson-Houston Co., Ltd., A. P. Young, and J. H. Butcher. January 23rd, 1923. (211,319.)

2,457. "Electrical resistances and the manufacture thereof." Dubilier Condenser Co. (1921), Ltd., and P. R. Coursey. January 26th, 1923. (211,324.)

5,591. "Electric motor starters." Igranic Electric Co., Ltd., and A. H. Curtis. February 26th, 1923. (211,347.)

6,698. "Switches for electric irons and the like." Electric and Hardware, Ltd., and F. J. Wineberg. March 8th, 1923. (211,351.)

8,194. "Collector rings for dynamo-electric machines." Metropolitan-Vickers Electrical Co., Ltd. April 13th, 1922. (196,263.)

9,104. "Electric contacts." B. Raettig. April 3rd, 1923. (211,366.)

9,331. "Vaporiser attachment for internal-combustion engines for heating by electricity the charge for internal-combustion engines." I. R. Mail, J. D. Mail, and J. St. G. Reynolds-Tait. November 9th, 1922. (206,807.)

9,979. "Means for series-connection of any two of a given number of electrical machines." Forges et Ateliers de Constructions Electriques de Jeumont Soc. Anon. December 27th, 1922. (209,016.)

10,385. "Electric fuse plug." H. E. V. Brückner. April 19th, 1922. (196,607.)

14,039. "Balancing machines." Metropolitan-Vickers Electrical Co., Ltd. July 5th, 1922. (200,489.)

14,254. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 30th, 1923. (211,391.)

14,750. "Electron discharge apparatus." British Thomson-Houston Co., Ltd. June 5th, 1922. (198,700.)

15,335. "Electrodes for electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). June 12th, 1923. (211,398.)

17,608. "Telephone or like earpiece." P. V. Summer. July 6th, 1923. (211,404.)

19,217. "Junction plug connectors for multiple-conductor electric cables." Soc. Anon. des Ateliers de Secheron. August 12th, 1922. (202,296.)

21,751. "Insulated conductor for the production of non-inductive cables." C. Cremer. December 8th, 1922. (208,118.)

21,938. "Automatic igniting apparatus for large mercury-vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. September 7th, 1922. (203,679.)

25,672. "Vacuum tubes of the 'audion' type." F. Peri. October 7th, 1922. (Addition to 205,038.) (205,511.)

25,674. "Vacuum tubes of the three-electrodes type." F. Peri. October 7th, 1922. (Divided application on 205,059.) (205,513.)

25,675. "Vacuum tubes of the three-electrodes type." F. Peri. October 7th, 1922. (Divided application on 205,059.) (205,514.)

28,520. "Windings of high-voltage transformers." Akt.-Ges. Brown, Boveri et Cie. November 24th, 1922. (207,518.)

29,608. "Closures for electrical primers for detonators, and apparatus employed in connection therewith." Etablissements Davey, Bickford & Smith, et Cie. Soc. Anon. Française. January 17th, 1923. (210,047.)

30,415. "Manufacture of electrical resistances." L. Verhaert. December 14th, 1922. (208,525.)

The I.M.E.A. Convention.—The twenty-ninth annual convention of the Incorporated Municipal Electrical Association will be held at Chester from June 16th to 21st, 1924. The preliminary programme is as follows:—Monday, June 16th: Reception by the President, followed by dancing at the Grosvenor Hotel. Tuesday, June 17th: Civic welcome by the Mayor of Chester (Councillor C. P. Cockrill, J.P.); address by Mr. S. E. Britton, president of the Association and City Electrical Engineer, Chester; paper and discussion, "Power Plant Chemistry," by Mr. W. M. Miles (Sheffield Electricity Department). In the afternoon there will be a visit to the Electric Power Station, Queensferry, the 33,000-volt overhead transmission line, and Hawarden Castle by charabanc, or to the antiquities of Chester, and Chester Cathedral. In the evening the Mayor and Mayoress will hold a reception at the Town Hall. Wednesday, June 18th: Paper and discussion on "Public Undertakings—Purpose, Policy and Management," by Councillor W. Hammer, Mayor of Hackney. Afternoon: A trip up the River Dee, in launches, to Eaton Hall, and tea at Iron Bridge. Thursday, June 19th: Paper and discussion on "Performance Guarantees for Power Plant, with Reference to Official Acceptance Tests," by J. N. Waite (Stoke-on-Trent Electricity Department). Afternoon: Visit to Ship Canal Portland Cement Works, Ellesmere Port, or to the British Insulated and Helsby Cables, Ltd.'s, works, or to Messrs. Bees Nurseries, or to a demonstration of a thrust boring machine. Evening: Annual dinner at the Town Hall, Chester, followed by dancing at the Grosvenor Hotel. Friday, June 20th: Annual general meeting. Afternoon: Visit to Messrs. Lever Bros'. Soap Works, Port Sunlight, or a trip to Llangollen. Evening: Social and dance at the Grosvenor Hotel. Saturday, June 21st: Visit to hydro-electric plant and distribution system in the rural district near Chester.